http://eclipse.org/ptp

## Introduction to the Eclipse Parallel Tools Platform

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## **Tutorial Outline**

Time (Tentative)	Module	Topics	Presenter
1:30-2:00	Eclipse Installation Intro/Overview	<ul> <li>Installation of Eclipse and PTP</li> <li>Eclipse overview</li> </ul>	Jeff/Jay
2:00-2:45	Eclipse basics	<ul> <li>Synchronized projects</li> <li>Git support</li> <li>Editor features</li> </ul>	Jeff
2:45-3:15	BREAK		
3:15-3:30	(continue Basics)		Jeff
3:30-4:30	Build & Run (1:00)	<ul> <li>GUI terminal</li> <li>Building with Make</li> <li>Target system configurations</li> <li>Launching a parallel application</li> <li>Modules/environment mgmt</li> <li>Wrap-up</li> </ul>	Jay

Installation instructions (and these slides) are available at http://wiki.eclipse.org/PTP/tutorials/XSEDE15

# Final Slides, Installation Instructions

 Please go to http://wiki.eclipse.org/PTP/tutorial s/XSEDE15 for slides and installation instructions
 Local copy of downloads: http://dns.conference.xsede.org/

# Installation

- + Objective
  - To learn how to install Eclipse and PTP
- + Contents
  - System Prerequisites
  - Eclipse Download and Installation of "Eclipse for Parallel Application Developers"
  - Installation Confirmation
  - Updating the PTP within your Eclipse to the latest release

## System Prerequisites

Local system (running Eclipse)

Linux (just about any version)

- MacOSX (10.5 Leopard or higher)
- Windows (XP on)

✦ Java: Eclipse requires Sun or IBM Java

- Only need Java runtime environment (JRE)
- + Java 1.7 or higher

+Java 1.7 is the same as JRE Version 7

- The GNU Java Compiler (GCJ), which comes standard on Linux, will not work!
- OpenJDK, distributed with some Linux distributions, comes closer to working, but should not be used.
- See http://wiki.eclipse.org/PTP/installjava

## Eclipse Packages

- The current version of Eclipse (4.5) is also known as "Mars"
- Eclipse is available in a number of different packages for different kinds of development
  - http://eclipse.org/downloads
- For PTP, we recommend the all-in-one download: 
  New! See next slide
  - Eclipse for Parallel Application Developers



Eclipse for Parallel Application Developers, Downloaded 46,871 Times Details

We often call this the "Parallel Package"

Install-3

for update

## New! Parallel Package updated

- The public Parallel Package on eclipse.org/downloads is only updated three times yearly
- We are now building updated all-in-one packages with new releases of PTP already installed.
  - You can use this, or just update the original one

See next slides for updating...

To use already-updated package:

- Go to http://eclipse.org/ptp/downloads.php
- Under File Downloads:
- Click on the link, and on the file downloads page, see
   Parallel Application Developers Package and download the appropriate file for your platform
  - Mac OS X
  - Linux X86 and X86\_64
  - Windows x86 and x86\_64
- Unzip or untar it



## Exercise

- 1. Download the "Eclipse for Parallel Application Developers" package to your laptop
  - Your tutorial instructions will provide the location of the package
  - Make sure you match the architecture with that of your laptop
- 2. If your machine is Linux or Mac OS X, untar the file
  - On Mac OS X you can just double-click in the Finder
- 3. If your machine is Windows, unzip the file
- This creates an eclipse folder containing the executable as well as other support files and folders

Installation

## Starting Eclipse

## + Linux

From a terminal window, enter "<eclipse\_installation\_path>/eclipse/eclipse &"

### Mac OS X

- + From finder, open the eclipse folder where you installed
- Double-click on the Eclipse application
- Or from a terminal window

#### + Windows

- Open the eclipse folder
- Double-click on the eclipse executable



# Specifying A Workspace

- Eclipse prompts for a workspace location at startup time
- The workspace contains all user-defined data
  - Projects and resources such as folders and files
  - The default workspace location is fine for this tutorial



# Eclipse Welcome Page

 Displayed when Eclipse is run for the first time Select "Workbench"



## Checking for PTP Updates

- From time-to-time there may be newer PTP releases than the Mars release
  - Mars and "Parallel package" updates are released only in September and February
- PTP maintains its own update site with the most recent release
  - Bug fix releases can be more frequent than base Eclipse (e.g. Luna), and what is within the parallel package

 You must enable (and install from) the PTPspecific update site before the updates will be found

Installation

# Updating PTP

#### Now select Help>Install New Software...

- In the Work With: dropdown box, select this update site, or enter it:
  - http://download.eclipse.org/tools/ptp/updates/mars

\varTheta 🔿 🔿 Install	
Available Software	
Check the items that you wish to install.	
$\frown$	
Work with: PTP - http://download.eclipse.org/tools/ptp/updates/luna	▼ Add
Find more software by working with the <u>Available</u>	Software Sites" preferences.
(type filter text	
Name	Version
III Fortran Development Tools (Photran)	
IOI Parallel Tools Platform	
III Remote Development Tools	
IOI Remote Services	
Select All Deselect All	
Details	

Installation

# Updating PTP (2)

 Easiest option is to "Select All" - which updates existing PTP features and adds a few more

Name						
	III Fortran Development Tools (Photran)					
	III Parallel Tools Platform					
☑	III Remote Development Tools					
	III Remote Services					

Note: for this tutorial, this installs extra features we'll refer to later anyway (TAU, PerfSuite)

Select Next to continue updating PTP

Select Next to confirm features to install

# Updating PTP (3)

### Accept the License agreement and select Finish

000	Installing Software
Installing Software	
Installing org.eclipse.ptp.pldt.up	c
<b>_</b>	
Always run in background	
C	Cancel Details >> Run in Background

# **Updating PTP - restart**

### Select Yes when prompted to restart Eclipse



# **Updating Individual Features**

- It's also possible (but a bit tedious) to update all the PTP features without adding any new features
  - + Open each feature and check the ones you want to update
  - Icons indicate: Grey plug: already installed Double arrow: can be updated Color plug: Not installed yet



Note: if network is slow, consider unchecking:

Contact all update sites during install to find required software

# Restart after Install

- If any new top-level features are installed, they will be shown on the welcome screen
- We only updated PTP, so we land back at C/C++ Perspective

00		C/C++ - Eclips	se – /Users/be	th/Documents/	workspace2			$\bigcirc$
] 【 • 日 읍 ≙ ] ☆ • û • ] 쉀 • 줘 • ♡ ◇ • → •		, ™ ] <b>% • ()</b>	• 🚱 • 💁 • ] 🙋	0 🖨 🖋 • ] 🔳 🛛	Π]Ο•]ψ		😭 🖬 c/c	
Project Explorer						- 0	E o 🕱 🔲 T	
E	\$ \$ ₹						An outline is not av	ige ♥
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		2 Problems 2	🖉 Tasks 🖳 (	Console 🔲 Prope	rties 🐌 Remo	te Environme	nts	° ∧ ∟ □
		Description		A	Resource	Path	Location	Туре
		▲	*****	******		****	******	)+
] 🗗					]			1

- Help>About or Eclipse > About Eclipse ...
   will indicate the release of PTP installed
- Further Help>Check for Updates will find future updates on the PTP Update site

## Exercise

- 1. Launch Eclipse and select the default workspace
- 2. Configure Eclipse to check for PTP updates
- 3. Update all PTP features to the latest level
- 4. Install the optional features of PTP, including TAU and PerfSuite

Selecting all features accomplishes 3. and 4.

5. Restart Eclipse once the installation is completed

# Introduction

## Objective

To introduce the Eclipse platform and PTP

## + Contents

- New and Improved Features
- + What is Eclipse?
- What is PTP?

# What is Eclipse?

- A vendor-neutral open-source workbench for multi-language development
- A extensible platform for tool integration
- Plug-in based framework to create, integrate and utilize software tools



Introduction

Intro-1

# **Eclipse Features**

- Full development lifecycle support
- Revision control integration (CVS, SVN, Git)
- Project dependency management
- Incremental building
- Content assistance
- Context sensitive help
- Language sensitive searching
- Multi-language support
- Debugging

# Parallel Tools Platform (PTP)

- The Parallel Tools Platform aims to provide a highly integrated environment specifically designed for parallel application development
- Features include:
  - An integrated development environment (IDE) that supports a wide range of parallel architectures and runtime systems
  - A scalable parallel debugger
  - Parallel programming tools (MPI, OpenMP, UPC, etc.)
  - Support for the integration of parallel tools
  - An environment that simplifies the end-user interaction with parallel systems
- http://www.eclipse.org/ptp



# Eclipse PTP Family of Tools



## How Eclipse is Used



# **Eclipse Basics**

## Objective

- Learn about basic Eclipse workbench concepts: projects,
- Learn about projects: local, synchronized, remote

## Contents

- Workbench components: Perspectives, Views, Editors
- Local, remote, and synchronized projects
- Learn how to create and manage a C project
- Learn about Eclipse editing features

# **Eclipse Basics**

- A workbench contains the menus, toolbars, editors and views that make up the main Eclipse window
- The workbench represents the desktop development environment
  - Contains a set of tools for resource mgmt
  - Provides a common way of navigating through the resources
- Multiple workbenches can be opened at the same time
- Only one workbench can be open on a *workspace* at a time



Basic-1

Eclipse Basics

## Perspectives

- Perspectives define the layout of views and editors in the workbench
- They are task oriented, i.e. they contain specific views for doing certain tasks:
  - + C/C++ Perspective for manipulating compiled code
  - Debug Perspective for debugging applications
  - System Monitoring Perspective for monitoring jobs
- You can easily switch between perspectives
- If you are on the Welcome screen now, select
   "Go to Workbench" now



# Switching Perspectives

Window Help

Minimize cuments/workspace Zoom **⇔** -2-**Toggle Full Screen** ^%F Q Ouick Access 😭 🔤 C/C++ Three ways of changing New Window - -- -🗄 O 🖾 **"**2 New Editor perspectives 🗙<sup>S</sup> 🛛 🔿 **Open Perspective** 🕸 Debua Show View Remote C/C++ Remote System Explorer Customize Perspective... Team Synchronizing 1. Choose the Window>Open Save Perspective As... Reset Perspective... int, char\*[]) Other... Perspective menu option Close Perspective Close All Perspectives Then choose Other... or message \*/ C/C++ (default) Navigation for receive CVS Repository Exploring Bring All to Front 🏇 Debug 2. Click on the **Open Perspective** button in the **Fortran** 🔚 Git Repository Exploring upper right corner of 🗱 Parallel Debug screen (hover over it to Planning Remote C/C++ see names) E Remote System Explorer ers/beth/Documents/workspace Resource 0. 200 System Monitoring ☐<sup>0</sup>Team Synchronizing 3. Click on a Q Quick Access C/C++ System Monitoring Tracing perspective X XML shortcut button Cancel OK

🙆 🔍 <u>ର୍</u> 🌖 🗳

# Which Perspective?

## The current perspective is displayed in the title bar

					oject.c - Eclipse SDK -
<u>F</u> ile	<u>E</u> dit	<u>S</u> ource Refac <u>t</u> or	<u>N</u> avigate	Se <u>a</u> rch <u>P</u> rojec	t <u>R</u> un <u>P</u> API <u>W</u> indow
] ∎≎~		≙ │ 励 │ @~ &~	<u>°</u> ~ °	≪ ⊗~   ‡·	· O· Q⊧· Q₂· │ O· │

# Views

 The workbench window is divided up into Views

- Edit Refactor Navigate Search Project Run Window 📓 🚵 🖬 💁 🗸 MyCproject.c 🖾 Project Explorer #include <stdio.h> #include <stdlib.h> 7 😂 MyCproject int main(void) { puts("!!!Hello World!!!"); prints return EXIT\_SUCCESS; D ... Debug 📮 Console Tasks 🖾 - 0 Outline 🖾 0 items Description Resource Iew stdlib.h main(void) : int • DI
- The main purpose of a view is:
  - To provide alternative ways of presenting information
  - For navigation
  - For editing and modifying information
- Views can have their own menus and toolbars
  - Items available in menus and toolbars are available only in that view
  - Menu actions only apply to the view
- Views can be resized



## **Stacked Views**

- Stacked views appear as tabs
- Selecting a tab brings that view to the
  - foreground

	Remote C/C++	- hello/hello.c	– Eclipse – /Users/be	th/ews/test0917c			
] ➡ + @ <b>@</b>   <b>@</b>   <b>@</b> + @ ] <b>@ @ %</b> + ] ■ <b>1</b> ] <b>%</b> + §		• 🕲 • ] 🏇 • 🖸	) • Q <sub>a</sub> • ] Ö •	🖹 🎬 P	arallel Run	t 😰 Remote C	
	C hello.c C ✓ /* Name Author Versia Copyri Descri */ #includ int mai put ret Console C-Build (hell	: hellol : ght : Your of ption : Hello e <stdio.h> e <stdib.h> n(void) { is("!!!Hello Wo urn EXIT_SUCCE</stdib.h></stdio.h>	copyright notice World in C, <u>Ansi</u> -sty	!!!Hello World )►	r 🕃 Re	Dutline S d stdio.h stdib.h main(void) : in mote Environm mote Environm	t
] 🗗 🕈	Writable	Smart Insert	1: Remote Tools DSto	ore Sc.edu): (100%)	<b></b>	] 🐴 奠 🗷	3 👻 🔶

## Expand a View

Double-click on a view/editor's tab to fill the workbench with its content;

Repeat to return to original size

] <mark>[] • □ © © © © © © © © © © © © © © © © © ©</mark>	\$• 63• 63• 63• (6• ) ≪• ⊗• • 62• 49• ) 0 1 1 (0)• ) (1)	Ê € C/C++	] \$	1		腔 िC/C++
Projec 🛛 🗖 🗖	le hello.c 🛛 🗖 🗖	E Outline 🛛 🗖 🗖	1	🖁 👷 Problems 🕱 🌛 Tasks 📮 Console		° ∧ – ₽ –
E S S V Mello Mincludes V S rc Double click	Copyright : Your copyright Description : Hello World in */ #include <stdio.h> #include <stdib.h> int main(void) { puts("!!!Hello World!!!") return EXIT_SUCCESS;</stdib.h></stdio.h>	<ul> <li>J<sup>2</sup><sub>Z</sub> R K<sup>S</sup> ● H ♥</li> <li>stdio.h</li> <li>stdlib.h</li> <li>main(void) : int</li> </ul>	P N	0 items	A Resource	Path Lo
	Problems 🕱 🖉 Tasks 🗟 Console	° ∧ – ⊟				
	0 items Description	Resource Path				
] <b>0</b> * ]			][	]*		

Window > Reset Perspective returns everything to original positions

Eclipse Basics

Basic-7

# Help

Display a me

#### To access help

- + Help>Help Contents
- Help>Search
- + Help>Dynamic Help
- Help Contents provides detailed help on different Eclipse features in a browser
- Search allows you to search for help locally, or using Google or the Eclipse web site
- Dynamic Help shows help related to the current context (perspective, view, etc.)

Help	
Search	
le Welcome	
Help Contents	
😵 Search Dynamic Help	
Key Assist Tips and Tricks & Report Bug or Cheat Sheets	
Eclipse Marketpla Check for Update Install New Softw	s
000	🐈 Help – Eclipse 🖉
Iz7.0.0.1:62675/help/inde	x.jsp C Reader O
& C Gmail How to Remon Mac OS X PTP he	lp ITHC - Requs - Mac OS IBM Mac forums Southern Flaauren Price >> 🗲
	All topics
Contents 👜 🖬 😽 🗖	
⊞ 🌳 Workbench User Guide ⊞ 🏶 Autotools Plug-in User Guide	
$\mathbb{E} \ $ $\mathbb{C}/\mathbb{C}++$ Development User Guide	
E C/C++ Library Documentation	Using the help system
🗄 🧇 ChangeLog Editor User Guide	
Eclipse Marketplace User Guide EGit Documentation	Browse topics in the <b>Contents</b> frame ( <sup>2</sup> ) on the left. Click on a topic to have it displayed. Use the <b>Back</b> and <b>Forward</b> buttons to navigate within the history of
E Fortran Development User Guide	viewed topics.
🗄 🧼 GCov User Guide	Searching
B Source Service S	, , , , , , , , , , , , , , , , , , ,
Elbhover Developer's Guide	To quickly locate topics on a particular subject in the documentation, enter a query in the <b>Search</b> field. Use the <b>Search</b> frame <i>(</i> ) to display the Search view. You can
Elline Streight Status E Streight Streight Status E Mylyn Documentation	narrow the scope of your search by selecting only the sections you are interested in.
🗄 🧇 Parallel Development User Guide	Synchronizing
<ul> <li>Profiling Framework User Guide</li> <li>Semote Development Tools User Guide</li> <li>SE User Guide</li> <li>Specfile Editor User Guide</li> </ul>	Clicking the <b>Show in Table of Contents</b> button ( <sup>(b)</sup> ) will select that topic in the navigation tree. The <b>Link with Contents</b> button ( <sup>(b)</sup> ) keeps the navigation tree synchronized to the current topic.
E TMF Developer Guide	Capabilities
🗄 🧇 Valgrind User Guide	To show documentation about capabilities that are disabled in the application, select
Simple a manual	the Show All Topics button (). This affects the table of contents and search results.



## **Eclipse Preferences**

00	Preferences
type filter text	Typing 🗘 🗸 🗢 🛪 💌
<ul> <li>type interfext</li> <li>General</li> <li>C/C++</li> <li>Appearance</li> <li>Autotools</li> <li>Build</li> <li>Code Analysis</li> <li>Code Style</li> <li>Debug</li> <li>Editor</li> <li>Content Assist Folding</li> <li>Hovers</li> <li>Mark Occurrences</li> <li>Save Actions</li> <li>Scalability</li> <li>Syntax Coloring</li> <li>Templator</li> <li>Typing</li> <li>File Types</li> <li>Indexer</li> <li>Language Mappings</li> <li>New CDT Project Wiza</li> <li>Property Pages Setting</li> <li>Task Tags</li> </ul>	Automatically close         ✓ "Strings"         ✓ (Parentheses) and [square] brackets         ✓          ✓ (Braces)         Tabulators         ✓ Tab key adjusts indentation of the current line         The tab display value (currently 4) and whether spaces are used to indent lines are configured on the code style preference page. The current indentation mode uses tabs.         When pasting         ✓ Adjust indentation         In string literals         ✓ Wrap automatically         □ Escape text when pasting into a string literal
Template Default Valu XL C/C++ Compiler	Automatically indent           Image: State Sta
XL C/C++ Language ( ChangeLog Fortran Help	Restore Defaults Apply
?	Cancel OK

- Eclipse Preferences allow customization of almost everything
- To open use
  - + Mac: Eclipse>Preferences...
  - Others:
     Window>Preferences...
- The C/C++ preferences allow many options to be altered
- In this example you can adjust what happens in the editor as you type.

## Preferences Example

kport...

haracters

OK

00	Preferences	
type filter text	Formatter	
▶General ▼C/C++		Project Specific Settings
Appearance Autotools	Active profile:	
▶ Build	K&R (built-in) + Edi	it Remove
Code Analysis		
▼Code Style	New Import	
Code Templetes	Preview:	
Formatter		
Name Style	/*	to Constitute and the
▶ Debug ▼Editor	* A sample source file for the cod	ae formatter previe
Content Assist	#include <math.h></math.h>	
		ile 'K&R [built-in]'
Hovers	Pioli	ie kak [built=ii]
Mark Occurrence	Profile name: K&R [built-in]	Expor
Save Actions	Traine name. Traine paine inf	
Scalability	Indentation Braces White Space New L	Lines Control Statements Line Wrapping Comments
Syntax Coloring		
Templates	General settings	Preview: Show invisible chara
Typing	Tab policy: Tabs only	÷ /* /*
File Types	Use tabs only for leading indentations	* Indentation
Indexer	Indentation size:	4 #include <math.h></math.h>
Language Mappings		
New CDT Project Wit	Tab size:	4 class Point { public:
Property Pages Setti Task Tags	Indent	Point(double x, double y) :
Template Default Va	'public', 'protected', 'private' within class body	×(x), y(y) {
XL C/C++ Compiler		
XL C/C++ Language	Declarations relative to 'public', 'protected', 'private'	<pre>double distance(const Point&amp; other) const; int compareX(const Point&amp; other) const;</pre>
	Statements within function body	double x;
	Statements within blocks	<pre>double y; };</pre>
	Statements within 'switch' body	15
T	Statements within 'case' body	<pre>double Point::distance(const Point&amp; other) const {</pre>
	✓ 'break' statements	<pre>double dx = x - other.x; double dy = y - other.y;</pre>
	Declarations within 'namespace' definition	return sqrt(dx * dx + dy * dy); }
	Empty lines	
	?	Apply Cancel O

More C/C++ preferences: + In this example the Code Style preferences are shown

> + These allow code to be automatically formatted in different ways

Eclipse Basics


### Exercise

- 1. Change to a different perspective
- 2. Experiment with moving and resizing views
  - Move a view from a stack to beside another view
  - Expand a view to maximize it; return to original size
- 3. Save the perspective
- 4. Reset the perspective
- 5. Open Eclipse preferences
- 6. Search for "Launching"
- 7. Make sure the "Build (if required) before launching" setting is *disabled*



## **Optional Exercise**

Best performed after learning about projects, CVS, and editors

- 1. Use source code formatting to format a source file, or a region of a source file
  - Use Source>Format menu
- 2. In Eclipse Preferences, change the C/C++ source code style formatter, e.g.
  - Change the indentation from 4 to 6
  - Make line wrapping not take effect until a line has a maximum line width of 120, instead of the default 80
  - Save a (new) profile with these settings
  - Format a source file with these settings
- 3. Revert the file back to the original experiment with
  - Replace with HEAD, replace with previous from local history, or reformat using original style

# Creating a Synchronized Project

#### ✦ Objective

- Learn how to create and use synchronized projects
- Learn how to create a sync project
  - +From a source code repository in Git

#### Contents

- Eclipse project types
- Clone a git repository; create a synchronized project
- Using synchronize filters
- Remote Terminal view

### **Project Location**

#### ✦ Local

- Source is located on local machine, builds happen locally
- This is the default Eclipse model

#### Synchronized

- Source is located on both local and remote machine(s), then kept in synchronization by Eclipse
- Building and launching happens remotely (can also happen locally)
- Used mainly for scientific and supercomputing applications
- There are also remote-only projects, but these have limitations and are not covered here

### Synchronized Projects



Synchronized Projects

#### Revision Control Systems (Source Code Repositories)

- Eclipse supports a range of revision control systems, such as CVS, Git, and Subversion (and others)
- These are distinct from synchronized projects
- Revision control systems can be used in conjunction with synchronized projects
- Synchronized projects are typically not used for revision control

# Synchronized Project Creation

#### Local -> Remote

- Projects start out local then are synchronized to a remote machine
- Three options
  - Created from scratch
  - Imported from local filesystem
  - + Imported from source code repository (Git) <- this tutorial
- Remote -> Local
  - Projects start out on remote machine then are synchronized to the local system
  - Two options
    - Already on remote system
    - Checked out from source code repository

### C, C++, and Fortran Projects Build types

#### Makefile-based

 Project contains its own build command – typically a makefile (or makefiles) for building the application – but can be any build scripts, etc.

#### Managed

 Eclipse manages the build process, no makefile required by the user

## Check out source code from Git repository

Create Synchronized project on the local machine at the same time.

Two steps:

- Clone Git Repo
- Create project files from within the clone

## Clone the git repo



C/C++ (default) CVS Repository Exploring



# In the view, select Clone a Git repository one of two ways

Synchronized Projects Sync-7

# Specify remote git repo location VRI: <u>https://github.com/xsede14/ptp-tutorial.git</u>

 Fill in URI and other fields fill themselves
 Select Next>

> Synchronized Projects

00	Clone	Git Repository		
Source Git Repositor Enter the location of	<b>bry</b> the source repositor	у.		GIT
Location URI: Host: Repository path:	git@github.com:xseo github.com xsede14/ptp-tutoria		ll.git	Local File
Connection Protocol: Port:	•			
Authentication User: Password: Store in Secure Sto	git			
?	< Back	Next >	Cancel	Finish

Sync-8

### Finish git cloning

Select Next> to choose the (only) branch
 Then select Finish> to use the default git destination (Remember this, you'll need it later)

😑 🔿 😑 Import Projects from Git	
Branch Selection Select branches to clone from remote repository. Remote tracking branches will be created to track updates for these branches in the remote repository.	Clone Git Repository  Local Destination Configure the local storage location for ptp-tutorial.
Branches of git@github.com:xsede14/ptp-tutorial.git:	
type filter text	Directory: //Users/beth/git/ptp-tutorial Browse Initial branch: master ÷ Clone submodules
Select All Deselect All	Configuration Remote name: origin Projects Import all existing projects after clone finishes
? < Back Next > Cancel Finish	Working sets Add project to working sets Working sets: \$ Select
nchronized	?     < Back

### Import project from cloned repo

- After repo is cloned, expand ptp-tutorial and Working Directory
   Git - Ed
- We are importing only one project
- Select shallow
- Right mouse,
   Import Projects...





### Create new project with wizard

 Select Use the New Project Wizard to be able to create the project as a Synchronized C/C++ project at creation

 Select Finish to finish the git cloning, and you will be taken to Sync project info next.

Cloning from git@github.com:xsede14/ptp.git
Select a wizard to use for importing projects Depending on the wizard, you may select a directory to determine the wizard's scope
Wizard for project import
O Import existing projects
• Use the New Project wizard
Import as general project
>Working Directory - /Users/beth/git/ptp-tutorial
< Back

# New Project Wizard

We are creating the project directly as a Synchronized C/C++ project

Expand Other
 Select
 Synchronized
 C/C++ Project
 Select Next>

	8 🔘 🖶	New Project		
!	Select a wizard Create a new Synchronized C or C++	- Project		
	Wizards:			
	type filter text			
	🕨 🧀 General			
	▶ 🧀 C/C++			
	Createrepo			
	<ul> <li>Every Fortran</li> <li>RPM</li> </ul>			
	► 🦢 Tracing			
	▼ 🛃 Other			
	Synchronized C/C++ Projec			
	😰 Synchronized Fortran Projec 🧀 Synchronized Project	ct		
	Examples			
	(?)	Next >	Cancel	Finish

### New Synchronized Project Wizard

### Enter the Project Name

✦ E.g. "shallow"

- Next we will specify the Local
   Directory where the local files are located (cloned from git)
  - Files are synchronized here, and we will edit them locally
- …and the Remote Directory
   where the remote files are located
  - Our remote target machine, where we will build, run, & debug
- Use Modify File Filtering... if required (see later slide)

	$\Theta \odot \Theta$	New	v Synchro	nized Project		
1	New Synchronized F					
	Project name must be	specified				
	Project name:					
	Local directory					
	🗹 Use default locat	tion				
	Local directory:				Bro	wse
	Remote directory					
	Connection name:	Please select a co	onnection		÷ N	ew
	Remote directory:				Brov	vse
	Modify file filtering.					
	Project Type			Remote Toolchain (selec	ct 1 or more)	
	🕨 🗁 GNU Autotools	i i				
	🕨 🗁 Executable					
	Executable (XL)					
	Shared Library					
	Shared Library	(XL UPC)				
	Static Library					
	Static Library ( Static Library ( Executable (XL)					
	Static Library()					
	Shared Library					
	A <sup>+</sup> → <sup>−</sup>	<i>C</i> ,		U		

#### See Next slides...

Synchronized Projects

### Local and remote directories

- For Local directory, NOTE: Uncheck Use default location and browse to the location you chose for git repo

   the shallow dir beneath that
- To specify the Remote directory, first Create a connection to the remote target machine by selecting New...

0 0	New Synchronized Project	
New Synchronized Proj Please select a project typ		C
Project name: shallow		
Local directory		
Use default location	/beth/git/ptp-tutorial/shallow	Browse
Remote directory		
Connection name:	lease select a connection	\$ New
Remote directory:		Browse

### Creating a Connection

- In the New Connection dialog
  - Enter a Connection name
     for the remote host
  - Enter host name, user name, and user password or other credentials
  - Select Finish

New Connection	en ies of a new connection
Connection nam Host informati	
Host:	gordon.sdsc.edu
User:	joverbey
O Public key	/ based auth Keys are set at <u>Network</u> <u>Connections, SSH2</u>
Passphrase:	
Password	based authentication
Password:	••••••
Advanced	
?	Cancel

### Specifying the remote directory

- After the connection has been specified, back in the New Synchronized Project window..
- For Remote directory, you can enter its location. If it does not exist, it will be created.
  - If the remote dir exists, you can select it with the Browse... Note that this is the first time that the Connection information is utilized.
- Later slides in this section show how to fix Connection if e.g. password or userid are entered incorrectly



000	New Synchronized Project	
New Synchron Create synchro	ized Project onized project of the selected type	
Project name: Local directo		
Use defau	It location ry: [/Users/beth/git/ptp-tutorial/shallow	Browse
Remote direct		: New Browse
lect directory: /home/	Project Location (trestles)	
<ul> <li>newnew</li> <li>shallow</li> <li>shallow_trestles2</li> <li>shallow-0525</li> <li>test</li> </ul>		
Show hidden files	Cancel OK	Sync-16

# Project Type & Toolchain

?

< Back

#### Choose the Project Type

- This tutorial's code has its own makefile, so use
   Makefile Project>Empty Project
- Otherwise, choose the type of project you want to create

#### Choose toolchain for remote build

 Use a toolchain that most closely matches the remote system

#### Choose a toolchain for the local build (OPTIONAL)

- This is optional if you don't plan to build on the local machine
- This is used for advanced editing/searching

Click Finish to create the project

Remote directory	
Connection name: trestles Remote directory: /home/tibbitts/shallow	New     Browse
Modify file filtering	
Project Type	Remote Toolchain (select 1 or more)
<ul> <li>Static Library</li> <li>Static Library (XL UPC)</li> <li>Executable (XL C/C++)</li> <li>Static Library(XL C/C++)</li> <li>Static Library(XL C/C++)</li> <li>Static Library(XL UPC)</li> <li>Executable (Gnu Fortran on Linux/*ni</li> <li>Executable (Gnu Fortran on MacOS X)</li> <li>Executable (IBM XL Fortran)</li> <li>Empty Project</li> <li>Empty Project</li> <li>Empty Project - Fortran</li> <li>Demo - Hello World - Fortran usir</li> <li>Demo - Calculate Pi - Fortran usir</li> </ul>	Other Toolchain Cygwin GCC GCC Fortran GNU Autotools Toolchain IBM XL Fortran Tool Chain Linux Berkeley UPC MacOSX Berkeley UPC MacOSX GCC MinGW GCC Solaris. GCC Local Toolchain (optional - select 0 or more) Other Toolchain Cygwin GCC GCC Fortran GNU Autotools Toolchain IBM XL Fortran Tool Chain Linux Berkeley UPC Linux GCC MacOSX Berkeley UPC Linux GCC MacOSX Berkeley UPC Linux GCC MacOSX GCC MinGW GCC Solaris. GCC

Next >

Sync-17

Finish

Cancel



### Project successfully created

- You should now see the "shallow" project in your workspace
- Project is synchronized with remote host

Status area in lower right shows Synchronization progress:

Remote Synchronization: (19%)





# Synchronized Project

- Back in the Project Explorer, decorator on project icon indicates synchronized project
- Double-+ icon





### Synchronize Filters

- If not all files in the remote project should be synchronized, a filter can be set up
  - For example, it may not be desirable to synchronize binary files, or large data files
- Filters can be created at the same time as the project is created
  - Click on the Modify File Filtering... button in the New Project wizard
- Filters can be added later
  - Right click on the project and select
     Synchronize>Filter...

### Synchronize Filter Dialog

- Files can be filtered individually by selecting/unselecting them in the File View at the top
- Include or exclude files based on paths and expressions



 Suggestion: add filter for 'shallow' so the executable, built on remote machine, doesn't get synced back



Patterns to include/exclude from the synchronization. The last matching pattern decides the outcome.

Pattern	Туре		Add
/.project /.cproject /.settings/ coredir.[0-9]*/ core core/	exclude exclude exclude exclude exclude include		Edit Remove
		Cancel	ОК

Synchronized Projects

Sync-21

### Synchronized Project Properties

- Synchronized configurations can be managed through the project properties
- Open the project properties by right-clicking on the project and selecting Properties
  - + Select Synchronize
- This is the same as using the Synchronize>Manage... menu

00	Properties for shallow
type filter text	Synchronize 🗘 🗸 🗸 👻
<ul> <li>Resource Builders</li> <li>C/C++ Build</li> <li>C/C++ General</li> <li>Fortran Build Paths and Symbols</li> <li>Project References</li> <li>Run/Debug Settings</li> <li>Service Configurations</li> <li>Synchronize</li> <li>Task Repository</li> <li>Task Tags</li> <li>Validation</li> </ul>	Local Add   Trestles Remove   Set Active    CDT Build Configurations   Default Configuration: Default_with_Linux_GCC +    Restore Defaults   Apply
?	Cancel OK

### Forcing a Resync

- If Auto-sync is set, the project should automatically resync with remote system when things change (e.g. after build)
- Sometimes you may need to do it explicitly
- Right click on project and select
   Synchronization>Sync Active
   Now
  - or use the toolbar icon



 Status area in lower right shows when Synchronization occurs

Build Configurations Make Targets Index	* * *		
Synchronize	$\mathbf{P}$	Sync Active Now	
Validate Show in Remote Systems view I Convert to Fortran Project Convert To Run As Debug As Profile As		Set Active Manage Sync All Now	•
	•	✓ Auto-Sync (Global) Auto-Sync Settings	►
	•	Filter	

Remote Synchronization: (31%)



Synchronized Projects

### **Remote Terminal**

- There is a remote terminal that can provide a shell from within Eclipse using the connection you created for your synchronized project
- Right-Click on your synchronized project and select "Show Terminal" Or
- If view is not in your workbench:
   Select Window>Show View>Other...
  - +Choose Terminal from the Terminal folder
- In the Terminal view, click on the Connect button



 It will use the previously configured connection from the dropdown, or create a new one ...more in Advanced Features section...

🖹 Problems 🧔 Tasks 📃 Console 🔲 Properties 🖉 Terminal 1 🛿 🍌 Remote	Environments
Remote Tools: (org.eclipse.ptp.remote.RemoteTools_trestles – CLOSED) – Encoding: (ISO-88	359-1)

Synchronized Projects

### **Changing Remote Connection Information**

- If you need to change remote connection information (such as username or password), open Preferences
  - + Win/Linux: Window > Preferences
  - + Mac: Eclipse > Preferences

and use **Remote Development >** Connections

000	Preference	S			
type filter text	Connections		⟨□ • □⟩ • ▼		
▶General ►C/C++ ChangeLog ▶Fortran	Remote Services: Built-in SSH +				
► Help	Status	N Host			
Install/Update Library Hover Mylyn Parailel Tools	open	trestles	trestles.sdsc.edu		
Remote Development Connections					
Remote Snell Remote Tools Service Configurations Synchronized Projects Remote Projects					
?		Cancel	ОК		

### **Remote Connections**

00			Preferences			
type filter text	Connectio	ns				(⊐ + ⊂) • ▼
General						
▶C/C++	Remote Se	ervices: Buil	t-in SSH 🔶			
ChangeLog						
▶ Fortran	Status	Connection	N Host	User		
▶ Help	open	trestles	trestles.sdsc.edu	tibbitts		Add
▶Install/Update	open	trestres	ci concono ci cono			
Library Hover						Edit
▶Mylyn ▶Parallel Tools						
Remote Development						Remove
Connections						
Remote Shell						Open
Remote Tools						
Service Configurations						Close
Synchronized Projects						
Remote Projects						
Remote Systems						
▶Run/Debug						
Specfile Editor					Restore Defaults	Annh
					Restore Defaults	Apply
?					Cancel	ОК

# To Edit a connection:

- Close the remote connection first
- Right-click and select Edit
  - Change host, userid, password, etc.

Note: Remote Host may be closed/stopped

- Any remote interaction starts it
- No need to restart it explicitly



### Exercise

- 1. Create a synchronized project
  - Your login information and source directory will be provided by the tutorial instructor
- Observe that the project files are copied to your workspace
- 3. Open a file in an editor, add a comment, and save the file
- 4. Observe that the file is synchronized when you save the file
  - Watch lower-right status area; confirm on host system



### **Optional Exercise**

- Modify Sync filters to not bring the \*.o files and your executable back from the remote host
  - Rebuild and confirm the files don't get copied

### **Editor Features**

Objective

Learn about Eclipse editor features

+ Contents

- Saving
- Editor markers
- Setting up include paths
- Code analysis
- Content assistance and templates

### Editors

- An editor for a resource (e.g. a file) opens when you double-click on a resource
- The type of editor depends on the type of the resource
  - .c files are opened with the C/C++ editor by default
  - You can use Open With to use another editor
  - In this case the default editor is fine (double-click)



Some editors do not just edit raw text

- When an editor opens on a resource, it stays open across different perspectives
- An active editor contains menus and toolbars specific to that editor

Editor Features

Editor-1

් \*hello.c හි

### Saving File in Editor

 When you change a file in the editor, an asterisk on the editor's title bar indicates unsaved changes

#### Save the changes by using Command/Ctrl-S or File>Save

Undo last change using Command/Ctrl Z

### Editor and Outline View

- Double-click on source file
- Editor will open in main view

- Outline view is shown for file in editor
- Console shows results of build, local runs, etc.



### Source Code Editors & Markers

- A source code editor is a special type of editor for manipulating source code
- Language features are highlighted
- Marker bars for showing
  - ✤ Breakpoints
  - Errors/warnings
  - + Task Tags, Bookmarks
- Location bar for navigating to interesting features in the entire file



Editor-4
## Remote Include Paths

- In order for editor and build features to work properly, *Eclipse needs to know* where your include files are located
  - The build environment on the remote host knows your include files etc., and will work fine without additional information
- ✦ But if we tell Eclipse also,
  - Then indexing, search, completion, etc. will know where things are

Two methods: A manual and B discover

Α

# Set Include Paths manually

- Open Project Properties
- Expand C/C++ General
- Select Preprocessor Include Paths
- Click GNU C, then CDT User
   Setting Entries, then click
   Add...
- In upper right, select
   File System Path in pulldown
- Check Contains System
   Headers
- A UNC-style path specifies
   //<connection>/<path>
- Enter Path //gordon/opt/openmpi/gnu/ib/incl ude
- Select OK



Editor Features

## A Include Paths con't

# After adding include directory, it should appear in the list



# A Include Paths con't (3)

### ✦ Select OK

### The C/C++ Indexer should run

Lower right status area indicates it

C/C++ Indexer: (54%)

### If not force it via Project Properties>Index>Rebuild

# B Set Include Paths automatically

- Project Properties > C/C++ General > Preprocessor Include Paths, Macros etc.
- 2. Select the "Providers" tab
- 3. Click on the checkbox for "Sync GCC Builtin Compiler Settings"
- 4. Open the window wider. You'll see a text box with "Command to get compiler specs"
  - It will read
  - \${COMMAND} -E -P -v -dD \${INPUTS}
  - Change \${COMMAND} to mpice, and click OK
- 5. Rebuild the index
  - Right click on project, Index > Rebuild
- 1. mpi.h and its symbols should now be resolved.

Set include paths automatically (con't)

$\Theta \cap \Theta$	Properties for shallow	
type filter text	Preprocessor Include Paths, Macros etc.	, ⇒, , , , , , , , , , , , , , , , , ,
type filter text Resource Builders C/C++ Build C/C++ General Code Analysis Documentation File Types Formatter Indexer Language Mappings Paths and Symbols Preprocessor Include Pat Profiling Categories XL C/C++ Language Opt Fortran Build Git Linux Tools Path Paths and Symbols Project References Run/Debug Settings Synchronize Task Repository Task Tags Validation WikiText		Clear Entries       Move Up       Move Down
	Restore Defau	ilts Apply
?	Cancel	ОК

Editor Features

Editor-10

Set include paths automatically (con't)

### You may see in lower right:

Discover compiler buil...ettings: (50%)

When it's done, Rebuild Index (Rightmouse on

project)

· · · · · · · · · · · · · · · · · · ·				)	
Build Configurations Make Targets	• •	ask	s 📃 Console	Properties	🖉 Terminal
Index		-	Rebuild		
inuex			Rebuild		
Synchronize	•				
Synemonize	-		Freshen All	Files	
Validate			Undate wit	h Modified Fi	las
validate			update wit	n Moainea Fi	les
Show in Remote Systems view			Re-resolve	Unresolved I	ncludes
			the state	A 1996 1997 1997	

The C/C++ Indexer should run

Lower right status area indicates it

C/C++ Indexer: (18%)

# Code Analysis (Codan)

- If you see bug icons in the editor marker bar, they are likely suggestions from Codan
  - + If include files are set correctly, they should not appear.
- Code checkers can flag possible errors, even if code is technically correct
- To turn them off, use Preferences Window > Preferences or Mac: Eclipse > Preferences
  - C/C++ > Code Analysis

and uncheck all problems

 Select OK to close
 Preferences







 If icons don't disappear: Right mouse on Project >
 Run C/C++ Code Analysis
 You can also enable/disable this per project in Project
 Properties
 Editor-12

.c

25 26

main.c 🖾

\* Commonwealth S

#include <math.h
#include <mpi.h>

## Line Numbers

Text editors can show line numbers in the left column

 To turn on line numbering:

- Right-mouse click in the editor marker bar (at editor left edge)
- Click on Show Line
   Numbers

i main.c ⊠	<pre>28 #include <stdio. "decs.h<="" #include="" 29="" pre=""></stdio.></pre>
⊕ * Commonwealth Scientific and Indu	32 MPI_Datatype *
Toggle Breakpoint Doubl Enable Breakpoint Breakpoint Types	33 34⊜ main (argc, argv 35 int argc; 36 char * argv
Run C/C++ Code Analysis Resource Configurations	37 { 38 float pi=4 39 float p[n]
Add Bookmark Add Task	40 float u[n]
✓ Show Quick Diff Show Annotation Show Line Numbers	个企Q ;urface height)
Folding	▶ <mark>tion</mark> */
Preferences Float Vola[n][m]; float h[n][m]:	

# Navigating to Other Files

### On demand hyperlink

- + In main.c line 135:
- Hold down Command/Ctrl key e.g. on call to initialise
- Click on initialise to navigate to its definition in the header file (Exact key combination depends on your OS)
- E.g. Command/Ctrl and click on initialise

### Open declaration

- Right-click and select Open
   Declaration will also open the file in which the element is declared
- E.g. in main.c line 29 right-click on decs.h and select Open Declaration





*/	Open Declaration	F3	
#include <st< td=""><td>Open Type Hierarchy</td><td>F4</td><td></td></st<>	Open Type Hierarchy	F4	
<pre>#include <st< pre=""></st<></pre>	Open Call Hierarchy	^ጊዝ	
	Quick Outline	жо	
int main(voi	Quick Type Hierarchy	ЖΤ	
puts("!! return E	<b>Explore Macro Expansion</b>	<b>#</b> =	rld!!
}	Toggle Source/Header	^Tab	

## Note: may need to left-click before right-click works

Editor Features

Editor-14

# Navigating to Remote Files

- Note: remote includes must be set up correctly for this to work
- On demand hyperlink
  - + In main.c line 73:
  - Ctrl-click on fprintf
  - stdio.h on remote system opens
- Open declaration (or F3)
  - In main.c, right-click and select
     Open Declaration e.g on <stdio.h>
  - + File from remote system is opened.
- Hover over editor name tab to see remote

location.



## **Content Assist & Templates**

 Type an incomplete function name e.g. "get" into the editor, and hit ctrl-space

Select desired completion value with cursor or mouse

13	5		
14	in	t mair	n(void) {
15	5	puts	<pre>s("!!!Hello World!!!"); /* prints !!!Hello World!!! */</pre>
16	ò	get	
17	7		e getchar_umocket(volu) . mt
18	5	ret	getdelim(char * *lineptr,*n,intdelimit
19	}		getenv(const char *name) : char *
20	)		getline(char * *lineptr,*n,FILE *strear
		5	<pre></pre>
			Press '^Space' to show Template Propos

 Code Templates: type 'for' and Ctrl-space

 17
 for

 18
 image: for - for loop

 19
 ret

 20 }
 image: for - for loop with temporary variable

 21
 image: for - for loop with temporary variable

More info on code templates later

Editor Features

Editor-16

Hit ctrl-space again

for code templates

### Hover Help

 Hover the mouse over a program element in the source file to see additional information

71	
( 1	
72	if(geteny())
73	
	Name: getenv
74	Prototype: char * getenv (const char *name)
75	Description:
76	This function returns a string that is the value of the environment variable name. You must not modify this
77	string. In some non-Unix systems not using the GNU library, it might be overwritten by subsequent calls to
78	getenv (but not by any other library function). If the environment variable name is not defined, the value is
79	null pointer.
	Header files:
80	stdlib.h
81	

### Inactive code

 Inactive code will appear grayed out in the CDT editor

```
260 #define VAL
261 #ifdef VAL
262 acopy_one_to_two(VAL, ds, res.indx);
263 #else
264 acopy_one_to_two(res.row, ds, res.indx);
265 #endif
```

```
260 //#define VAL
261 #ifdef VAL
262 acopy_one_to_two(VAL, ds, res.indx);
263 #else
264 acopy_one_to_two(res.row, ds, res.indx);
265 #endif
```

Editor Features

Editor-18



### Exercise

- Open an editor by double clicking on a source file in the Project Explorer
- Use the Outline View to navigate to a different line in the editor
- 3. Back in main.c, turn on line numbering
- 4. In main.c, ctrl-click on line 99, master\_packet, should navigate to its definition in the file
- 5. In worker.c, line 132, hover over variable p to see info
- Try the exercises at the end of the "Basics" section, if you haven't already, since you now have some project/source files to play with.



# **Optional Exercise**

- 1. Type "for", then activate content assist
  - Select the for loop with temporary variable template, insert it, then modify the template variable
  - Surround the code you just inserted with "#if 0" and "#endif" and observe that it is marked as inactive
  - Save the file
- 2. What do these keys do in the editor?
  - Ctrl+L; Ctrl+Shift+P (do it near some brackets)
  - Ctrl+Shift+/;
  - Ctrl+Shift+Y and Ctrl+Shift+X (do it on a word or variable name e.g.)
  - Alt+Down; Alt+Up
- 3. To make sure you didn't do any damage,
  - Select any source files you changed and do rightmouse > replace with ...
    - (if you made project from CVS) ....Latest from HEAD
    - + (If you made project from remote files) ... Local History ....
  - Observe that your changes are gone.

Editor Features

Editor-20

# **MPI Programming**

Objective

Learn about MPI features for your source files

+ Contents

- Using Editor features for MPI
- ✦ MPI Help features
- Finding MPI Artifacts
- MPI New Project Wizards
- MPI Barrier Analysis

## **MPI-Specific Features**

 PTP's Parallel Language Development Tools (PLDT) has several features specifically for developing MPI code

- Show MPI Artifacts
- Code completion / Content Assist
- Context Sensitive Help for MPI
- Hover Help
- MPI Templates in the editor
- MPI Barrier Analysis

 PLDT has similar features for OpenMP, UPC, OpenSHMEM, OpenACC

## Show MPI Artifacts

### In Project Explorer, select a project, folder, or a single source file

The analysis will be run on the selected resource(s)

- Run the analysis by clicking on dropdown menu next to the analysis button
- Select Show MPI Artifacts



## MPI Artifact View

- Markers indicate the location of artifacts in editor
- The MPI Artifact View lists the type and location of each artifact
- Navigate to source code line by double-clicking on the artifact
- Run the analysis on another file (or entire project!) and its markers will be added to the view
- Click on column headings to sort
- 🔸 Remove markers via 🗙



## **MPI Editor Features**



## **Context Sensitive Help**

- Click mouse, then press help key when the cursor is within a function name
  - Windows: F1 key
  - + Linux: ctrl-F1 key
  - MacOS X: Help key or Help ► Dynamic Help
- A help view appears (Related Topics) which shows additional information (You may need to click on MPI API in editor again, to populate)
- Click on the function name to see more information
- Move the help view within your Eclipse workbench, if you like, by dragging its title tab



#### MPI\_Comm\_rank – Determines the rank of the calling process in the communicator.

MPI Programming

## **MPI** Templates

### Allows quick entry of common patterns in MPI programming



Add more templates using Eclipse preferences! C/C++>Editor>Templates Extend to other common patterns

mpisr – MPI Send Receive

## MPI Barrier Analysis

⇒ C/C++ - MyBarrier/src/MyBarrier.c - Eclipse SDK - C:\ews\runtime-cdt40											
File Edit Refactor Source Statis	File Edit Refactor Source Statistics Navigate Search Project Run Window Help										
i 📬 ▾ 📰 🗁   📾 i 🎯 ▾ 🞯 ▾ 🞯 ▾ 🧭 ▾ I i 🦓 ▾ 🕲 ▾ I i 🏇 ▾ 🕗 ▾ i 🅭 🖋 i 🗊 🖨 i 🕙 ▾ 🖺 靴 i ½ ▾ 🖓 ▾ 🏷 ▾ ⇔ ▾											
🔓 Project Explorer 🖄 🦳 🗆 🕼 matrixio.c 🔀 zzzzTemplateTest.c 📓 MyBarrier.c 🖄 🦹 4 👘 🕀 Outline 🖄 💿 Make Targets 🖓 🗖											
			rank !=0){								
	_		create mes	sage */						J <mark>a</mark> z 📎 ১	
😑 🔂 MyBarrier				ge, "Greeting	s from pi	roces	ss %d! 👝		stdio.h		
🕀 👘 Includes			t = 0;		-				string.h		
🖨 🔂 src		/*	use strlen-	+1 so that '\	0' get ti	ransı	mittec		mpi.h		
🕀 🔂 MyBarrier.c		MPI	Send (messa	age, strlen(m	- essage)+1	L, MH	PI CH#		Barrier(): vo		
E : C Debug E : C MyCproject			dest, tag,	MPI_COMM_WOR	LD);		-		main(int, cha	ar≊∐)∶int	
	11	MPI	Barrier (M	PI_COMM_WORLD	);		-				
		}									
		else{									
		_		process 0: Nu	-						
		for		1; source < p	-						
			_	message, 100,	_		ource,				
				COMM_WORLD,							
			printf("%	s\n",message)	;						
3											
		}									
			_	(MPI_COMM_WOR	LD);						
MPI Barriers 🕱 🗖 🗖	ŋ		PI_Barrier rier();	(MPI_COMM_WOR	LD);		~				
			_		LD);		~				
i V		Bar 3	rier();				>				
i ✓ Function		Bar 3	rier();					ors 🛛		i	
i V Function		Bar 3	rier();				>	_		-	▼ □ □ Function
i ⊽ Function W main W main		Bar 3 Problems 2 Ta:	rier();	Barrier Matches	EX I	~	> Barrier Erro	ning Set		-	
i ♥ Function 000 main 000 main		Bar	rier();	Barrier Matches	X i i LineNo		Barrier Erro Barrier Match	ning Set	er(s))	-	Function
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Verify barrier synchronization in C/MPI programs

- For verified programs, lists barrier statements that synchronize together (match)
- For synchronization errors, reports counter example that illustrates and explains the error

### Local files only

MPI Programming

## MPI Barrier Analysis (2)

 Run the Analysis:
 In the Project Explorer, select the project (or directory, or file) to analyze



 Select the MPI Barrier Analysis action in the pulldown menu



## MPI Barrier Analysis (3)

# No Barrier Errors are found (no pop-up indicating error)

Two barriers are found

🗯 Eclipse	File	Edit	Source	Re	factor	Naviga	ate Sea	arch	Project	Run	Window	Help
00				_	C	C/C+	+ - sha	llow/r	main.c – I	Eclipse –	/Users/be	th/ews/
] 📬 🖬 🗟 🛓	<b>b</b> ] (	<b>₫</b> • 63•		-] 4	<b>、</b> • ⊗ • ]	🏇 • 🕻	) • 8∰ • (	<b>≥</b> •]	😕 🗁 🛷	?•] 🔳	T ] 🗗 ]	₽ .
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<ul> <li>shallow [cvs.</li> <li>calc.c 1.1</li> <li>copy.c 1.1</li> <li>decs.h 1.3</li> <li>diag.c 1.1</li> <li>dump.c 1.1</li> <li>dump.c 1.1</li> <li>n dump.c 1.2</li> <li>n init.c 1.2</li> <li>n main.c 1.4</li> <li>time.c 1.2</li> <li>tstep.c 1.1</li> </ul>	1	🖃 🥞		2000 2000 2000 2000 2000 2000 2000 200	8 9 00 1 } e 02 03 /* 04	retur (tid ! worke MPI_B MPI_F else {	<pre>= 0) { r(); arrier() inalized process</pre>	MPI_CO	OMM_WORLI	D);		
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MPI Programming

## MPI Barrier Analysis Views

				Barrier Matches 🖇	3 -	' 🗆	M Barrier Errors 🕅 j	
	i 🌣				i	$\overline{\nabla}$	Barrier Matching Set	Function
	Function	Barrier Matching Set	Function	Filename	LineNo	•	Error	main
<b>///</b>	main	Barrier 1 (2)	Barrier	MyBarrier.c	8		⊕ /// Path 1 (1 barrier(s))	
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970 r	main	Barrier 3	main	MyBarrier.c	41		⊖	main
970 r	main	🖃 📶 Barrier 2 (1)	main	MyBarrier.c	31		Loop (dynamic number of barriers)	
/// r	main	Barrier 2	main	MyBarrier.c	31			
<b>////</b> E	Barrier	Barrier 3 (2)	main	MyBarrier.c	41			
		Barrier 1	Barrier	MyBarrier.c	8			
		Barrier 3	main	MyBarrier.c	41			
	7	Barrier 4 (0)	main 🔺	MyBarrier.c	57			
		🕀 🚧 Barrier 5 (1)	main	MyBarrier.c	62			
<		<			>	)		>
8 ∎≎							:   🖓 🖓	조 😻 🔶

### **MPI Barriers view**

Simply lists the barriers

Like MPI Artifacts view, double-click to navigate to source code line (all 3 views)

MPI Programming

Barrier Matches view Groups barriers that match together in a barrier set – all processes must go through a barrier in the set to prevent a deadlock

### Barrier Errors view

If there are errors, a counter-example shows paths with mismatched number of barriers

## Barrier Errors

Let's cause a barrier mismatch error

 Open worker.c in the editor by double-clicking on it in Project Explorer

- At about line 125, enter a barrier:
  - Type MPI\_B
  - Hit Ctl-space
  - Select MPI\_Barrier
- prv = worker[PREV]; 120 121 nxt = worker[NEXT]; 122 jstart = worker[JSTART]; 123 jend = worker[JEND]; 124 \$125 MPI\_B 126 /\* MPI\_Barrier(MPI\_Comm ) int Blocks each task until 127 recei MPI\_Bcast(void\*, int, MPI\_Datatype, int, MPI\_ 128 \*/ MPI\_Bsend(void\*, int, MPI\_Datatype, int, int, 129 MPI\_Bsend\_init(void\*, int, MPI\_Datatype, int,i 130 for MPI\_Buffer\_attach( void\*, int) int 131 MPI Buffer detach( void\*, int \*) int 132
- Add communicator arg MPI\_COMM\_WORLD and closing semicolon



# Barrier Errors (2)

### Save the file

- CtI-S (Mac Command-S) or File > Save
- Tab should lose asterisk indicating file saved



### Run barrier analysis on shallow project again

 Select shallow project in Project
 Explorer first



# Barrier Errors (3)

Barrier Error is found
Hit OK to dismiss dialog



+ Code diverges on line 87

One path has 2 barriers, other has 1

🔐 Pr MPI Barrier Matches MM MPI Barriers MM MPI Barrier Errors 💥 Function Filename IndexNo Barrier Matching Set LineNo V Error main main.c 87 0 Path 1 (2 barrier(s)) 0 MBarrier 1 89 main.c main 1 worker.c A Rarrier 3 worker 125 з Path 2 (1 barrier(s)) 0 0 MBarrier 2 main.c 206 2 main

Double-click on a row in Barrier Errors view to find the line it references in the code

MPI Programming

## Fix Barrier Error

- Fix the Barrier Error before continuing
- Double-click on the barrier in worker.c to quickly navigate to it



- Remove the line and save the file
- Re-run the barrier analysis to check that it has been fixed

### **Remove Barrier Markers**

Run Barrier Analysis again to remove the error
Remove the Barrier Markers via the "X" in one of the MPI Barrier views



## MPI New Project Wizards

Quick way to make a simple MPI project
File > New > C Project

"MPI Hello World"
 is good for trying out
 Eclipse for MPI

$\Theta \cap \Theta$		C Pro	oject	
C Project Project nan	ne must be specified			
0	ne: fault location /Users/beth/ews/testptp			Browse
				bioliseiii
	Choose file system: default		÷	
Project typ	e:		Toolchains:	
🔻 🔁 GNU	J Autotools		MacOSX Berkeley UPC	
🗎 🗧 E	mpty Project		MacOSX GCC	
	ello World ANSI C Autotools Projec	t	XL C/C++ Tool Chain	
	Autotools Shared Library Project			
V 🔁 Exec				
	mpty Project			
	iello World UPC Project iello World ANSI C Project			
	API Hello World C Project			
-	API Pi C Project			
	API Pi C++ Project			
	/PI Empty C Project			
	OpenMP Hello World C Project			
	OpenMP Empty C Project			

## MPI New Project Wizards (2)

Next> and fill in (optional) Basic Settings

$\Theta \cap \Theta$	C Project
Basic Settings Basic properties of a p	roject
Author	Polly Parallel
Copyright notice	Your copyright notice
Hello world greeting	Hello MPI World
Source	src
? < Back	Next > Cancel Finish

 Next> and fill in MPI Project Settings
 Include path set in MPI Preferences can be added to project

$\Theta \cap \Theta$	C Project	
MPI Project Settings		$\rightarrow$
	th, lib name, library search path, and build be automatically be added to the new project.	
🧭 Add MPI project settir	ngs to this project	
🗹 Use default informati	on	
Include path:		Browse
Library name:		
Library search path:		Browse
MPI compile command:	mpicc	
MPI link command:	mpicc	
(7)	Back Next > Cancel	Finish

## MPI New Project Wizards (3)

### Select Finish and "MPI Hello World" project is created

Project Ex 않 □ □ Project Ex 않 □ □ Project Ex 않 □ □ Project Ex % □ Pro		v Qar Qar  ℓ uick Access	Image: C        Image: C          O ⊠       **2       Image: C          Image: C        Image: C        Image: C
Project Ex SS □ □ e helloM e ← helloMPI helloMPI f helloMPI f helloMS f helloMPI f helloM	MPLC ☎ mme : helloMPI.c[] nclude <stdio.h> nclude <string.h> nclude "mpi.h"</string.h></stdio.h>	_	0⊠ <sup>2</sup> 2 <sup>□</sup> □ □ ↓ <sup>2</sup> <sub>2</sub> ℝ <sup>4</sup> ↓ <sup>2</sup> <sub>2</sub> ℝ <sup>4</sup> ↓ <sup>2</sup> <sub>2</sub> ℝ <sup>4</sup>
E Src ♥ Na ♥ Control Notes #in	me : helloMPI.c[] iclude <stdio.h> iclude <string.h> iclude "mpi.h"</string.h></stdio.h>		P ↓ <sup>a</sup> <sub>Z</sub> ≥  Stdio.h
	<pre>int my_rank; /* rank of process * int p; /* number of process int source; /* rank of sender */ int dest; /* rank of receiver int tag=0; /* tag for message char message[100]; /* stora MPI_Status status; /* return st</pre>	es */ */ ge for m	string.h J mpi.h main(int, ch:
6 MPI Artifacts found	ems 🛛 📮 Console 🐁 Remote Environn	nents Resource	Path

## **MPI** Preferences

Settings for MPI New Project wizards

### MPI Include paths, if set in MPI Preferences, are added in MPI New

**Project Wizard** 

$\Theta \bigcirc \Theta$	Preferences	
type filter text	МРІ	⇔•≎•▼
<ul> <li>Mylyn</li> <li>Parallel Tools</li> <li>Debug</li> <li>External Tools</li> <li>GEM         <ul> <li>Launch</li> <li>Parallel Language Develo</li> <li>MPI</li> <li>OpenACC</li> <li>OpenSHMEM</li> <li>UPC</li> <li>Resource Managers</li> <li>Viewer</li> <li>Remote Development</li> <li>Remote Systems</li> <li>Run/Debug</li> <li>Specfile Editor</li> </ul> </li> </ul>	<ul> <li>Recognize MPI Artifacts by prefix (MPI_) alone?</li> <li>MPI include paths:</li> <li>MPI build command (C): mpicc</li> <li>MPI build command (C++): mpic++</li> <li>Prompt to include MPI APIs found in other locate</li> </ul>	New Remove Up Down ions (C only)?
?	Cancel	ОК
### Exercise

- 1. Find MPI artifacts in 'shallow' project
  - Locate all the MPI communication (send/receive) calls
- 2. Use content assist to add an api call
  - E.g., Type MPI\_S, hit ctl-space
- 3. Use hover help
- 4. Use a template to add an MPI code template
  - On a new line, type mpisr and ctl-space...



### **Optional Exercise**

- 1. Insert an MPI\_Barrier function call into one of your source files using content assist
  - + E.g. Line 125 of worker.c
- 2. Save the file
- 3. Run Barrier Analysis on the project
- 4. Locate the source of the barrier error and remove the statement
- 5. Re-run barrier analysis to observe that the problem has been fixed

# Building a Project

### Objective

 Learn how to build an MPI program on a remote system

Contents

- How to change build settings
- How to start a build and view build output
- How to clean and rebuild a project
- + How to do environment configuration with modules
- How to create build targets

### **Build Configurations**

- A build configuration provides the necessary information to build the project
- The build configuration information is specified in the project properties
- Projects can have multiple build configurations, each configuration specifies a different set of options for a build
- Open the properties by rightclicking on the project name in the Project Explorer view and selecting Properties (bottom of the context menu list)



Note: Fortran projects are a superset of C/C++ projects, so they have properties for both

# Build Properties (1)

#### C/C++ Build

- Main properties page
- Configure the build command
- Default is "make" but this can be changed to anything
- Build Variables
  - Create/manage variables that can be used in other build configuration pages

#### Environment

Modify/add environment variables passed to build

#### Logging

Enable/disable build logging

#### $\bigcirc \bigcirc \bigcirc$

type filter text Resource **Builders** ▼C/C++ Build **Build Variables** Environment Logging Settings **Tool Chain Editor** XL C/C++ Compiler ▼C/C++ General Code Analysis Documentation File Types Formatter Indexer Language Mappings Paths and Symbols Preprocessor Include Paths, Macros etc. **Profiling Categories** XL C/C++ Language Options CVS Fortran Build Paths and Symbols Project References **Refactoring History Run/Debug Settings** Synchronize Task Repository Task Tags ► Validation WikiText

# Build Properties (2)

#### Settings

- Binary parser selection (used to display binaries in Project Explorer)
- Error parser selection (used to parse the output from compiler commands)
- Tool Chain settings (managed projects only)

#### Tool Chain Editor

 Allows the tools in a particular tool chain to be modified

#### XL C/C++ Compiler

Compiler settings for XL C/C++ compilers (if installed)

#### C/C++ General/Preprocessor Include Paths...

+ Set include paths here

#### $\bigcirc \bigcirc \bigcirc$

type filter text Resource Builders ▼C/C++ Build Build Variables Environment Logging Settings Tool Chain Editor XL C/C++ Compiler ▼C/C++ General Code Analysis Documentation File Types Formatter Indexer Language Mappings Paths and Symbols Preprocessor Include Paths, Macros etc. Profiling Categories XL C/C++ Language Options CVS Fortran Build Paths and Symbols Project References Refactoring History Run/Debug Settings Synchronize Task Repository Task Tags Validation WikiText

# Selecting Build Configuration

#### Multiple build configurations may be available

- Synchronized projects will usually have a remote and a local build configuration
- Build configurations for different architectures
- The active build configuration will be used when the build button is selected
- The Build Configurations project context menu can be used to change the active configuration
  - Right click on project, then select the build configuration from the Build Configurations > Set Active menu

Close Unrelated Projects			
Build Configurations	•	Set Active	✓ 1 Default_with_Linux_GCC
Make Targets Index		Manage	2 Default_with_MacOSX_GCC
Synchronize	•	Build All Clean All	
Validate Show in Remote Systems vie	w	Build Selected	

Building a Project

Build-4

# **Building Synchronized Projects**

- When the build button is selected, the "active" build configuration will be built on the remote system specified by the "active" synchronize configuration
- The build and synchronize configurations are independent
  - It is possible to change which build configuration is active, but make sure this makes sense on the remote system specified in the synchronize configuration
- Right mouse on Project,
   Synchronize > Manage...
- A build configuration can be associated / with a synchronize configuration, so that it is automatically selected when the synchronize configuration is changed

😑 🔿 🔿 Manage Synchronize Configuration	S
►Local ► trestles	Add
► tresties	
	Remove
	Set Active
CDT Build Configurations	
Default Build Configuration: Default_with_Linux_G	cc ÷
Use an environment management system to custo remote build environment	mize the
	01
Cancel	ОК

### Configuring the Build Environment

- If the remote system has an environment system (such as Modules) installed, a custom set of modules can be configured for building C/C++ projects
- In the Manage Synchronize / Configurations dialog, select the configuration you wish to change
- Check Use an environment / management system to customize the remote build environment

0	0 0	Manage Synchroniz	e Configurations	
	►Local ►trestles			Add Remove Set Active
/	Manually specify environn	written.	remote build environment d on the Environments page of the p Selected Modules	÷ broject properties are set Up Down Set Default
				Cancel OK

# Build Environment (2)

- Select a module from the Available Modules list and click the Add-> button to add them to the Selected Modules list
- Use the <-Remove button to remove modules from the Selected Modules list
- Use the Filter list field to quickly find modules with a given name
- Use the Up and Down buttons to change the order of the Selected Modules
- Click Select Defaults to load only those modules that are present in a new login shell

0	0 0	Manage Synchronize Configurations	
	►Local ► trestles		Add Remove Set Active
->	<ul> <li>Manually specify environm</li> </ul>	agement system to customize the remote build environment ment configuration commands . Environment variables configured on the Environments page of the project prope written. any character): Add -> <- Remove	÷ erties are set Up Down Set Default
		Cancel	ОК

#### We'll do this for tutorial in a few slides...

≪.-

### Build Environment (3)

When you build the project, Eclipse will

- Open a new Bash login shell
- + Execute *module purge*
- Execute module load for each selected module
- ✤ Run make
- Module commands are displayed in the Console view during build
- Beware of modules that must be loaded in a particular order, or that contain common paths like /bin or /usr/bin

```
E Console 
CDT Build Console [shallow]
17:53:20 **** Build of configuration Default_remote for project shallow ****
make all
***** Environment configuration script temporarily stored in /tmp/ptpscript_rhMesG ****
module purge >/dev/null 2>&1
module load cuda-4.0.17
module load cupti/4.0.17
module load cupti/4.0.17
module load cupti/4.0.17
```

```
Building a Project
```

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### Build Environment (4)

- For this tutorial, we want to use gcc and Open MPI
- To get to this dialog: Right mouse on Project,
   Synchronize > Manage...
- Navigate to gnu in Available Modules and select Add ->
- Navigate to openmpi\_ib and select Add ->
- Assure the order matches this
  - If not, use Up/Down buttons

Manage Synchronize Configur	ations		-	
⊳ Local				Add
> trestles				Add
				Remove
				Set Active
CDT Build Configurations				
Default Build Configuration:	Default			-
Use an environment mana environment	gement syster	m to customize the	e remote build	
Manually specify environn	nent configura	tion commands		
Available Modules			Selected M	- dules
R		Add ->		
R/3.0.1		<- Remove	gnubase/1.0 gnu/4.8.2	
amber			openmpi_ik	/1.6.5
amber/14		L	1 1-	
apbs	-			
Reload List				
			ок	Cancel

# Start with original 'shallow'

Start with original 'shallow' code:

Project checked out from git:

Right mouse on project,
 Replace With > HEAD Revision



Replace With	HEAD Revision
Restore from Local History	Git Index
Show Terminal	Previous Revision

Also see Compare With ...

- + Other project:
  - +Right mouse on project,
    - Restore from local history finds deleted files

 Right mouse on file, Compare With or Replace With

### Starting the Build s-

Select the project in Project Explorer



 Click on the solution hammer button in toolbar to run a build using the active build configuration



 By default, the Build Configuration assumes there is a Makefile (or makefile) for the project

Building a Project

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### Viewing the Build Output

#### Build output will be visible in console

🖹 Problems 🧟 Tasks 📮 Console 🛛 🔲 Properties 🖉 Terminal 1 🐁 Remote Environ 🛛 🚦 History 🔗 Search 🖵 🗖
CDT Build Console [shallow]
15:42:20 **** Build of configuration Default_with_Linux_GCC for project shallow ****
make all
**** Environment configuration script temporarily stored in /tmp/ptpscript_JRDyM8 ****
module purge >/dev/null 2>&1
module load gnu
module load openmpi_ib
make all
Note: mpicc appears to invoke gcc
mpicc -g -c -o calc.o calc.c
mpicc -g -c -o copy.o copy.c
mpicc -g -c -o diag.o diag.c
<pre>mpicc -g -c -o init.c</pre>
mpicc -g -c -o main.o main.c
mpicc -g -c -o time.c
mpif90 -g -c -o tstep.o tstep.f90
mpicc -g -c -o worker.c
mpicc -g -c -o dump.o dump.c
mpicc -g -o shallow calc.o copy.o diag.o init.o main.o time.o tstep.o worker.o dump.o -lm -lgfortran
> Shell Completed (exit code = 0)

15:42:29 Build Finished (took 8s.753ms)

### **Build Problems**

- C/C++ - shallow/main.c - Eclipse - /Users/greg/Documents/workspace 😭 📅 C/C++ 🔥 Resource 📲 Team Synchr... 🧱 Parallel Debug - C >> 👸 • 🖓 • 🏷 🔶 • 🔿 - -- 0 - 8 Project Explorer 문 Out 없 🔪 🛞 Mak calc.c 🔂 main.c 🖾 if (tid != 0) {  $\nabla$ 87 💱 📲 😿 🔊 📲 FI 🕏 88 worker(); 🖌 🚟 shallow 🛛 [cvs.ncsa.uiuc.edu] Math.h MPI\_Barrier(MPI\_COMM\_WORLD); 89 🛀 mpi.h calc.c 1.1 MPI\_Finalize(): 90 copy.c 1.1 stdio.h 91 } else { decs.h 1.3 92 decs.h 93 /\* master process \*/ diag.c 1.1 worker() : void 94 dump.c 1.1 ++ setup\_res() : MPI\_Datatype 95 chunk\_size = n / (proc\_cnt - 1); Includes main(int, char\*[]) 96 init.c 1.2 setup\_res() : MPI\_Datatype for (i = 1: i < proc\_cnt: i++) { main.c 1.4 update\_global\_ds(MPI\_Data 98 /\* calculate each worker's boundary \*/ master\_packet[JSTART] = (i - 1) \* chunk\_size; 100 tstep.c 1.1 101 if (i == proc\_cnt - 1) orker.c 1.2 102 moster\_packet[JEND] = n - 1; AG aclocal.m4 1.1 else AUTHORS 1.1 104 master\_packet[JEND] = i \* chunk\_size - 1; Changelo 105 compile 1.1 106 if (i == 1) config.guess 1.1 107 prv = proc\_cnt-1; config.h.in 1.1 108 else 109 config.sub 1.1 prv = i-1;110 configure 1.1 master\_packet[PREV] = prv; AG configure.ac 1.1 COPYING 1.1 113 if (i == proc\_cnt - 1) depcomp 1.1 114 nxt = 1;INSTALL 1.1 else hinstall-sh 1.1 116 nxt = i+1: Makefile.am 1.1 Makefile.in 1.1 118 master\_packet[NEXT] = nxt; ) 4 + ) 4 ) Makefile.mk 1.1 ~ - missing 1.1 | Tasks 📃 Console 🔲 Properties 🗟 Remote Environments 📄 🗗 History Proble NEWS 1.1 3 errors, 0 warnings 0 others README 1.1 Desc Resource Path Location Type V Contraction (Sitems) 🔕 syntax error before ':' token /shallov line 97 C/C++ Pro main. () syntax error before ')' token main.c /shallow line 97 C/C++ Problem 😣 syntax error before "return' main.c /shallow line 212 C/C++ Problem ∎≎ syntax error before ':' token
- Build problems will be shown in a variety of ways
  - Marker on file
  - Marker on editor line -
  - + Line is highlighted
  - Marker on overview ruler.
  - Listed in the Problems
     view

 Double-click on line in Problems view to go to location of error in the editor

Building a Project

Build-13

### Forcing a Rebuild

- If no changes have been made, make doesn't think a build is needed e.g. if you only change the Makefile
- In Project Explorer, right click on project; Select Clean Project
- Build console will display results

 Rebuild project by clicking on build button again





### Forcing a Resync

- Project should resync with remote system when things change
- Sometimes you may need to do it explicitly
- Right mouse on project,
   Synchronize>Sync Active Now
- Status area in lower right shows when Synchronization occurs

Remote Synchronization: (73%)



Ъ Project Expl	orer 🛿			
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► 🚮 wor 🔒 ecli	Build Configurations	►		
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	Synchronize		Sync Active Now	
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	E Convert to Fortran Project Convert To		✓ Auto-Sync (Global) Auto-Sync Settings	•
	Profile As Debug As	* *	Filter	

# Creating Make Targets

### ✤ By default

- The build button will run "make all"
- Cleaning a project will run "make clean"
- Sometimes, other build targets are required
- Open Make Target view
- Select project and click on New Make Target button
- Enter new target name
- Modify build command if desired
- New target will appear in view
- Double click on target to activate



### Exercise



- 1. Start with your 'shallow' project
- 2. Build the project
- 3. Edit a source file and introduce a compile error
  - In main.c, line 97, change ';' to ':'
  - Save, rebuild, and watch the Console view
  - Use the Problems view to locate the error
  - Locate the error in the source code by double clicking on the error in the **Problems** view
  - + Fix the error
- 4. Rebuild the project and verify there are no build errors



### **Optional Exercise**

- Open the Makefile in Eclipse. Note the line starting with "tags:" – this defines a make target named tags.
- 2. Open the **Outline** view while the Makefile is open. What icon is used to denote make targets in the Outline?
- 3. Right-click the **tags** entry in the Outline view. Add a Make Target for **tags**.
- 4. Open the Make Target view, and build the tags target.
- 5. Rename Makefile to Makefile.mk
- 6. Attempt to build the project; it will fail
- 7. In the project properties (under the C/C++ Build category), change the build command to: make -f Makefile.mk
- 8. Build the project; it should succeed

### **Running an Application**

### Objective

Learn how to run an MPI program on a remote system

### + Contents

- Creating a run configuration
- Configuring the application run
- Monitoring the system and jobs
- Controlling jobs
- Obtaining job output

### Creating a Run Configuration

		Run Configurations		
		Create, manage, and run	configurations	
	(ro launch history)	Create a configuration to laun	ch a parallel application in Parallel Perspective	
				_
	<u>R</u> un As >		Configure launch settings from this dialog:	
	Ru <u>n</u> Configurations	type filter text	Press the 'New' button to create a configuration of the selected type.	
	Organize Favorites.	C C/C++ Application	Press the 'Duplicate' button to copy the selected configuration.	
		<ul> <li>Fortran Local Applicat</li> <li>Launch Group</li> </ul>	💢 - Press the 'Delete' button to remove the selected configuration.	
	Oner the run configuration	Parallel Application	- Press the 'Filter' button to configure filtering options.	
▼	Open the run configuration		- Edit or view an existing configuration by selecting it.	
	dialog Run>Run			
	Configurations		Configure launch perspective settings from the <u>Perspectives</u> preference page.	
✦	Select Parallel Application			
+	Select the New button			
	Or, just double-click on	۰ III >		
	Parallel Application	Filter matched 4 of 4 items		
				1
	to create a new one	?	Run Close	

Note: We use "Launch Configuration" as a generic term to refer to either a "Run Configuration" or a "Debug Configuration", which is used for debugging.

# Set Run Configuration Name

- Enter a name for this run configuration
  - ✤ E.g. "shallow"
- This allows you to easily re-run the same application
- If the "shallow" project was selected when the dialog was opened, its name will be automatically entered

00	Run Configurations
Create, manage, and run config	urations
🔇 No target system configuration h	as been selected
Yee       Image: Second	Name:       shallow
Filter matched 5 of 13 items	
?	

# Configuring the Target System

- In Resources tab, select a Target System Configuration that corresponds to your target system
  - + Use Generic Torque Batch
- Target system configurations can be *generic* or can be specific to a particular system
- Use the specific configuration if available, or the generic configuration that most closely matches your system
- You can type text in the box to filter the configurations in the list



### **Configure the Connection**

- Choose a connection to use to communicate with the target system
- If no connection has been configured, click on the New button to create a new one
  - Fill in connection information, then click ok
- The new connection should appear in the dropdown list
- Select the connection you already have to gordon.sdsc.edu
- Select toggle if you don't want to see popup again

$\Theta \cap \Theta$	Run Configurations		
Create, manage, and run configurations			
(Application): Application program	n not specified		
Image: Second system         type filter text         C/C++ Application         C/C++ Remote Application         Fortran Local Application         Parallel Application         Barallel Application         Barallel Application	Name: shallow          Image: shallow		
	Basic Settings Advanced Settings Import Script		
	Name Value Description		
	Job Name: ptp_job The name assigned to the job by the qsub or qalte		
	Account: Account to which to charge this job.		
	Queue:		
	Number of nodes:         1         Number and/or type of nodes to be reserved for e [usage hint] number_nodes:ppn=N		
$\Theta \cap O$	Open Connection		
Filter matched This config to continue	uration will run a command on the target system "trestles". Do you want ? Apply Revert		
Don't ask to run	Close Run		
	No Yes		

### **Resources Tab**

- The content of the Resources tab will vary depending on the target system configuration selected
- This example shows the TORQUE configuration
- For TORQUE, you will normally need to select the Queue and the Number of nodes
- For parallel jobs, choose the MPI Command and the MPI Number of Processes

Name	Name: shallow				
I⊒ R	esources 🖺 Application	🕬= Arguments 🔤 Environm	ent Synchronize 🔲 Common		
	Target System Configuration: edu.sdsc.trestles.torque.batch				
	Connection Type ↓ Local ● Remote trestles ↓ New				
		Basic Setting	gs Advanced Settings Import Script		
	Name	Value	Description		
	Job Name:	ptp_job	The name assigned to the job by the qsub or qalter command.		
	Account:		Account to which For this tutorial:		
	Queue:	<b>(</b>	Designation of the Queue: normal		
	Number of nodes:	1	Number and/or ty         Number of nodes: 1:ppn=5           [usage hint] nume         MPI Command: mpirun		
	Total Memory Needed:		Maximum amoun • MPI Number of Processes: 5 • Leave other fields alone		
	Wallclock Time:	00:30:00	Maximum amoun		
	MPI Command:	\$	Which mpi command to use.		
	MPI Number of Processes:	1	the '-np' value [usually equals Nodes*ppn]		
	Export Environment:	٢	All variables in the qsub command's environment are to be exported to the batch job.		
	Modules to Load:	Configure	Modules that will be loaded inside the job script.		
	View Script	View Configuration Re	store Defaults		

### **Configure Environment Modules**

- + Click on the *Modules to Load:* **Configure...** button
- Check the Use an environment management system to customize the remote build environment box if it is not already checked
- Select the required modules and click Add -> (you can either select one at a time, or all at once)

Click ok	<ul> <li>Configure Environment Management System</li> <li>Use an environment management system to customize the remote build environment</li> <li>Manually specify environment configuration commands</li> <li>Select modules to be loaded. Environment variables configured on the Environments page</li> </ul>			For this tutorial, use the following modules: • gnu • gnubase • openmpi_ib		
	beforehand and may be overwritten. Filter list (* = any string, ? = any character):		l			
	Available Modules null nwchem nwchem/6.3 octave octave/3.6.4 openmpi-x86_64 openmpi_ib/ openmpi_ib/1.6.5 papi papi/5.3.0 parmetis	Add -> <- Remove	Selected Modules gnu/4.8.2 gnubase/1.0		Up Down Set Default	
	Reload List			Cancel	ОК	

Running an Application

### Viewing the Job Script

- Some target configurations will provide a View Script button
- Click on this to view the job script that will be submitted to the job scheduler
- Batch scheduler configurations should also provide a means of importing a batch script

Account:			Account to which to charge this job.	
Queue:	shared	\$	Designation of the queue to which to submit the job	
Number of nodes:	1:ppn=	5	Number and/or type of nodes to be reserved for exc [usage hint] number_nodes:ppn=N	1
Total Memory Needed:			Maximum amount of memory used by all concurrent	:
Wallclock Time:	00:30:0	0	Maximum amount of real time during which the job	¢
MPI Command:	mpiru		Which mpi command to use	Script with
MPI Number of Processes	-	Script with current va	lues	Script with
Export Environment:	۷	#!/bin/bashlogin		
View Script	Viev	<pre>#!/bin/bashlogin #PBS -q shared #PBS -N ptp_job #PBS -I nodes=1:ppn=5 #PBS -V MPI_ARGS="-np 5" if ["-np" == "\${MPI_ARGS}"]; then MPI_ARGS= fi cd /oasis/scratch/trestles/\$USER/\$PBS_JOBID cp /home/tibbitts/shallow/shallow . MYSCREXE=`basename /home/tibbitts/shallow/shallow` COMMAND=mpirun if [ -n "\${COMMAND}"]; then COMMAND="\${COMMAND} \${MPI_ARGS} -hostfile \${PBS_NODEFILE} \${MYSCREXE} " else COMMAND="\${MYSCREXE}" fi </pre>		

### **Application Tab**

- Select the Application tab
- Choose the Application program by clicking the Browse button and locating the executable on the remote machine
  - Use the same "shallow" executable
- Select Display output from all processes in a console view

00	Run Configurations
Create, manage, and run con Create a configuration to launo	
Image: Second system         type filter text         Image: C/C++ Application         Image: Fortran Local Application         Java Applet         Java Applet	Name:       shallow         Image: Browse       Image: Browse         Shallow       Browse         Application program:       /home/tibbitts/shallow/shallow         Image: I
?	Close Run

# Arguments Tab (Optional)

- The Arguments tab lets you supply command-line arguments to the application
- You can also change the default working directory when the application executes

00	Run Configurations
Create, manage, and run con Create a configuration to launch	
Image: Second system       Image: Second system         Image: Secon	Name: shallow          Resources       Application       Arguments         Program arguments       Working directory         Image: State of the state
Filter matched 7 of 7 items	Using Parallel Application Launcher - <u>Select other</u> Apply Revert
?	Close Run

# Environment Tab (Optional)

- The Environment tab lets you set environment variables that are passed to the job submission command
- This is independent of the Environment Management (module/softenv) support described on previous slide

$\Theta \bigcirc \Theta$		Run Configurations		
Create, manage, and run con Create a configuration to launch	-			
[ ] 🗮 🗶 📄 券 •	Name: shallow			
type filter text	😫 Resources 🖹 App	lication 🕪= Argunents 🚾 Environment	Synchronize 🔲 Common	
C/C++ Application	Environment variables to set:			
F Fortran Local Applicatio	Variable	Value	New	
Java Application			Select	
▼  ☐ Parallel Application     shallow			Edit	
			Remove	
	<u> </u>	ent to native environment vironment with specified environment		
Filter matched 7 of 7 items	Using Parallel Applicat	tion Launcher - <u>Select other</u>	Apply Revert	
?			Close Run	

# Synchronize Tab (Optional)

- The Synchronize tab lets you specify upload/download rules that are execute prior to, and after the job execution
- Click on the New upload/download rule buttons to define rules
- The rule defines which file will be uploaded/downloaded and where it will be put
- Can be used in conjunction with program arguments to supply input data to the application

$\Theta \bigcirc \Theta$	Run Co	onfigurations		
Create, manage, and run configurations Add synchronization rules to upload files before the launch or to download files after the application terminates.				
Ype filter text         C C/C++ Application         € Eclipse Application         Fortran Local Application         Ø Java Applet         Java Application         JujUnit         Ö JUnit Plug-in Test         ► Launch Group	Synchronize rules:	Arguments       Environment       Synchronize       C         ore application starts.       Download rules are executed after         O       O         Upload Rule       Please specify the remote directory and a list of files that shall be up		
<ul> <li>OSGi Framework</li> <li>♥ Parallel Application</li> <li>Shallow-torque</li> </ul>	Upload rules enabled	Remote directory: Vuse directory from launch configuration Remote directory: Selected file(s):	Add files: File(s) Directory	
Filter matched 11 of 11 items	Using Parallel Application Laun		Workspace Remove files: Remove selected	
?		Options for all selected file(s):         Readonly       Executable         Download back if changed       Preserve time attributes         If file already exists:       Overwrite       ‡         ?       Cancer	el OK	



# Common Tab (Optional)

- The Common tab is available for most launch configuration types (not just Parallel Application)
- Allows the launch configuration to be exported to an external file
- Can add the launch configuration to the favorites menu, which is available on the main Eclipse toolbar
- Select Run to launch the job

00	Run Configurations	
Create, manage, and run confi Create a configuration to launch		
Image: Second system         Image: Second system <td>Name:       shallow-torque</td> <td></td>	Name:       shallow-torque	
Filter matched 11 of 11 items	Using Parallel Application Launcher - <u>Select other</u> Apply Revert	
?	Close Run	

### Run

### Select Run to launch the job

### You may be asked to switch to the System Monitoring Perspective



Select Remember my decision so you won't be asked again

Select Yes to switch and launch the job

# System Monitoring Perspective



Running an Application

Scroll to see more

Run-15
## Moving views

- The System Monitoring Perspective overlaps the Active Jobs and Inactive Jobs views
- To split them apart and see both at once, drag the tab for the Inactive Jobs view to the lower half of its area, and let go of mouse

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# System Monitoring

- System view, with abstraction of system configuration
- Hold mouse button down on a job in
   Active Jobs view to see where it is running in System view
- Hover over node in System view to see job running on node in Active Jobs view

│ <mark>⋶</mark> ⁺ ᇏ ᇡ ᆮ │ क़ॆ│ॐ᠇ <b>⊘</b> ᠇│ <b>ॶ</b> - <b>∿</b> ₁│;≘	🎒 🖋 ▼   ∠   ½ + № + +	$\langle \mathbf{v} \Rightarrow \mathbf{v} \mid \underline{\mathbf{w}}$	Q Quick Access	😰 📰 System Monitoring 📴 C/C++
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Welcome to Forge NCSA's DELL login node running RedHat 6 and has NVIDIA Tesla M2070's				
See for more detailed information about this system. http://www.ncsa.illinois.edu/UserInfo/Resources/Har				
			LML DA I	Driver (forgeinois.edu): (90%) 🛛 🐨

One node with 16 cores

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# Job Monitoring

- Job initially appears in Inactive Jobs view
- Moves to the Active Jobs view when execution begings
- Returns to Inactive Jobs
   view on completion
- Status refreshes automatically every 60 sec
- Can force refresh with menu

00	🕙 🕙 📄 System Monitoring – shallow/Makefile.m										se –	/Us	sers	/betl	n/ev	/s/t	est1
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Run-18

# **Controlling Jobs**

- Right click on a job to open context menu
- Actions will be enabled IFF
  - The job belongs to you
  - The action is available on the target system
  - The job is in the correct state for the action
- When job has COMPLETED, it will remain in the Inactive Jobs view



iii Ina	ctive Jol	bs 🖾							ν,	- 6	3
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	501	grw		?	?	?	?	COMPLETED			

# **Obtaining Job Output**

- After status changes to COMPLETED, the output is available
  - + Right-click on the job
  - Select Get Job Output to display output sent to standard output
  - Select Get Job Error to retrieve output sent to standard error
- Output/Error info shows in Console View
- Jobs can be removed by selecting Remove Job Entry

III Inad	ctive Jobs 🕱									
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### Add a Monitor

### You can monitor other systems too

### In Monitors view, select the '+' button to

add a monitor

🔄 Monitors 🛿	► ■ 🔗 🔶 🗖
Status Connection N	Name System Type
🔄 🔁 gordon	TORQUE Resource Manager
🔄 🔄 trestles.sdsc.	.edu TORQUE Resource Manager

 Choose monitor type and connection; create a new connection if necessary



Running an Application

Double click new monitor to start

### Exercise

- 1. Start with your 'shallow' project
- 2. Create a run configuration
- 3. Complete the Resources tab
- 4. Select the executable in the Application tab
- 5. Submit the job
- Check the job is visible in the Inactive Jobs view, moves to the Active Jobs view when it starts running (although it may be too quick to show up there), then moves back to the Inactive Jobs view when completed
- 7. View the job output
- 8. Remove the job from the Inactive Jobs view

### **Tutorial Wrap-up**

### Objective

- How to find more information on PTP
- Learn about other tools related to PTP
- See PTP upcoming features

### Contents

- Links to other tools, including performance tools
- Planned features for new versions of PTP
- Additional documentation
- How to get involved

# Useful Eclipse Tools

Linux Tools (autotools, valgrind, Oprofile, Gprof)
 <u>http://eclipse.org/linuxtools</u> (part of Parallel package)

+ Python

http://pydev.org

+ Ruby

http://www.aptana.com/products/radrails

Perl

+ <u>http://www.epic-ide.org</u>

+ VI bindings

- + Vrapper (open source) http://vrapper.sourceforge.net
- viPlugin (commercial) http://www.viplugin.com

WrapUp-1

# **Online Information**

### Information about PTP

- PTP online help
  - http://help.eclipse.org
- Main web site for downloads, documentation, etc.
   http://eclipse.org/ptp
- Wiki for designs, planning, meetings, etc.
   http://wiki.eclipse.org/PTP

Information about Photran
 Main web site for downloads, documentation, etc.
 http://eclipse.org/photran

# Mailing Lists

### User Mailing Lists

+ PTP

http://dev.eclipse.org/mailman/listinfo/ptp-user

- Photran
  - http://dev.eclipse.org/mailman/listinfo/photran
- Major announcements (new releases, etc.) low volume
  - http://dev.eclipse.org/mailman/listinfo/ptp-announce
- Developer Mailing Lists
  - Developer discussions higher volume
    - http://dev.eclipse.org/mailman/listinfo/ptp-dev

# Getting Involved

See http://eclipse.org/ptp
 Read the developer documentation on the wiki

 http://wiki.eclipse.org/PTP

 Join the mailing lists

- Attend the monthly developer meetings
  - Conf Call Monthly: Second Tuesday, 1:00 pm ET
  - Details on the PTP wiki

## PTP Tutorial Wrap-Up

Your feedback is valuable!

Thanks for attending We hope you found it useful

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