Visual Tools for the Analysis of Embedded Applications
Specific Requirements for Embedded

- Time Predictability
- Safety-Criticality

Presented Tools

- JamaicaVM ThreadMonitor
- VeriFlux
ThreadMonitor Overview

- Runtime Monitoring Tool
  - connects to running VM via socket
  - VM records low-level scheduling decisions
  - time stamps using CPU cycle counter
  - User events also possible
ThreadMonitor Demo
VeriFlux Overview

• Static Analysis Tool
  - based on abstract interpretation
  - finds superset of possible values for all variables
  - uses object-context
  - analyses threads
  - knows RTSJ (Scoped Memory, NHRTT, etc.)
# Comparison of Methods

<table>
<thead>
<tr>
<th>VeriFlux</th>
<th>JUnit</th>
</tr>
</thead>
<tbody>
<tr>
<td>automatic</td>
<td>manual</td>
</tr>
<tr>
<td>false positives</td>
<td>no false positives</td>
</tr>
<tr>
<td>no false negatives</td>
<td>tests may be incomplete</td>
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<tr>
<td>finds runtime errors</td>
<td>also semantic errors</td>
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<tr>
<td>proofs absence of errors</td>
<td>inherently incomplete</td>
</tr>
<tr>
<td>analyses code</td>
<td>executes code</td>
</tr>
<tr>
<td>whole program</td>
<td>partial program</td>
</tr>
</tbody>
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How does VeriFlux Work?

• Example

```java
... 
if (device instanceof MyDevice)
{
    MySensor s = (MySensor) device.sensor;

    int value = s.reading();
    ...
}
... 
```
How does VeriFlux Work?

Example

```java
... if (device instanceof MyDevice) {
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```

NullPointer
How does VeriFlux Work?

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- device != null
- device != null
- ClassCastException
- NullPointer
- NullPointer
How does VeriFlux Work?

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if (device instanceof MyDevice)
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- `device != null`
- `ClassCastException`
- `NullPointerException`
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How does VeriFlux Work?

• Example

```java
... if (device instanceof MyDevice) {
    MySensor s = (MySensor) device.sensor;
    int value = s.reading();
    ...
} ...
values(MyDevice.sensor)
```
How does VeriFlux Work?

• Example

```java
... if (device instanceof MyDevice) {
    MySensor s = (MySensor) device.sensor;
    int value = s.reading();
... }
... 
values(MyDevice.sensor) contains only MySensor
```

- ClassCast
- Nullable
- NullPointer
How does VeriFlux Work?

Example

```java
if (device instanceof MyDevice) {
    MySensor s = (MySensor) device.sensor;
    int value = s.reading();
    ...
} else {
    ...
}
```

values(MyDevice.sensor) contains only MySensor
How does VeriFlux Work?

- Example

```java
... if (device instanceof MyDevice) {
    MySensor s = (MySensor) device.sensor;
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- ClassCastException
- NullPointer

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How does VeriFlux Work?

- Example

```java
if ( device instanceof MyDevice ) {
    MySensor s = (MySensor) device.sensor;
    int value = s.reading();
    ...
}
... 

null ∉ values(MyDevice.sensor)
```
How does VeriFlux Work?

Example

```java
if (device instanceof MyDevice) {
    MySensor s = (MySensor) device.sensor;
    int value = s.reading();
    ...
}
...
```

null \notin values(MyDevice.sensor)
How does VeriFlux Work?

Example

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if (device instanceof MyDevice)
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VeriFlux Demo
Questions

- ???