Debugging

- **Primitive numerical types**
  - **Shorthand assignment statements**
  - **Type conversions**
- **Using Javadocs**
- **Using jdb - the Java debugger**
  - **Commands**

Primitive Numerical Types

- **"Shorthand" assignments**

  <assign-stmt> $\rightarrow$ **<var >** **++** ***//increment by 1***

  <assign-stmt> $\rightarrow$ **<var>** **--** ***//decrement by 1***

  <assign-stmt> $\rightarrow$ **<var>** += **<expr>** ***//incr by <expr>***

  <assign-stmt> $\rightarrow$ **<var>** –= **<expr>** ***//decr by <expr>***
  value

- **Synonyms**

  `i++` **and** **`i+=1`**

Type Conversions
Primitive Numerical Types

- ***Widening*** **- a value conversion without loss of precision**

  int $\rightarrow$ **`double`, `long` $\rightarrow$ `double`**

- ***Narrowing*** **- a value conversion with possible loss of precision - needs a type cast**

  double $\rightarrow$ int

  `(int)6.6` yields `6`

  To obtain a rounded value must use Math.round()

  class method invocation: <classname>.<method_name>

Using Javadocs

- **Java runtime system contains many standard packages which you can use (import) in your Java programs**
- **Click on Java Development Kit Packages on cs111 Java Documentation**
- **Interesting Java API Packages:**

  package java.applet

  package java.awt

  package java.beans

  package java.io

  package java.lang

  package java.math

  package java.util

java.lang Package Webpage

- **Lists interfaces, classes, exceptions and errors associated with this package**

package java.lang

Boolean

Byte

Character

Math

...

Math Class in java.lang

Class java.lang.Math

java.lang.Object

|

+----java.lang.Math

class relationships

public final class Math

extends Object

The class Math contains methods for performing basic numeric operations such as the elementary exponential, logarithm, square root, and trigonometric functions.

class description

Math Class Details

- **Lists variables and methods of class with signatures, followed by additional info**
- **abs(double)**

  Returns the absolute value of a double value.

public static double abs(double a)

Returns the absolute value of a double value. If the argument is not negative, the argument is returned. If the argument is negative, the negation of the argument is returned.

Parameters:

a - a double value.

Returns:

the absolute value of the argument.

Math.abs(3.0)

Debugging with jdb

- **Used UStime-procs-err.java to seed an error in UStime-procs.java and show how jdb works.**

- **Also in main method added new method invocation:**

```
String t = null;
System.out.println((z.timeConvert(t))
   + "in San Francisco \n");
```

Error-seeded Method

```
public UStime timeConvert(String s) {
   int d, timeDiff;
   UStime t = new UStime(0,0);
   if (s == "Pacific") timeDiff = 3;
       else if (s == "Mountain") timeDiff = 2;
       else if (s == "Central")  timeDiff = 1;
       else
   {System.out.println("Error in input time zone given" +
       s.toString());
       System.exit(1);
       timeDiff = 0;}
   t.hours = (this.hours + 12 - timeDiff) % 12;
   if (t.hours == 0)  t.hours = 12;
   t.minutes = this.minutes;
   return t;
}
```

UStime-procs-err.java

added an unnecessary call to toString() on a String object

How to run jdb?

22 remus!111> javac -g UStime-procs-err.java

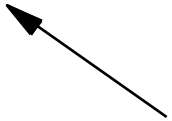
23 remus!111> jdb

Initializing jdb...

> run UStime

running ...

java program



class with main method to run

jdb output

```
running ...
main[1] Twelve noon EST is 11 hours and 0 minutes in
   Chicago
Twelve noon  EST is 10 hours and 0 minutes in Denver
Twelve noon  EST is 9 hours and 0 minutes in San
   Francisco
Uncaught exception: java.lang.NullPointerException
   at UStime.timeConvert(UStime-procs-err.java:23)
   at UStime.main(UStime-procs-err.java:51)
   at sun.tools.debug.MainThread.run(Agent.java:55)
main[1]
```

call chain of trace

list

```
main[1] list
19 else if (s == "Mountain") timeDiff = 2;
20 else if (s == "Central")  timeDiff = 1;
21 else
22 {System.out.println("Error in input time zone given"
  +
23      =>                  s.toString());
24                          System.exit(1);
25                          timeDiff = 0;}
26 t.hours = (this.hours + 12 - timeDiff) % 12;
27 if (t.hours == 0)  t.hours = 12;
main[1]
```

locals

main[1] locals

Method arguments:

this = 12 hours and 0 minutes

s = null

Local variables:

timeDiff is not in scope

t = 0 hours and 0 minutes

timeDiff is not in scope

timeDiff is not in scope

timeDiff is not in scope

indicates timeDiff has not yet been initialized on this execution path

Navigating the call chain

```
main[1] where
  [1] UStime.timeConvert (UStime:23)
  [2] UStime.main (UStime:51)
  [3] sun.tools.debug.MainThread.run (MainThread:55)
main[1] up
main[2] locals
Method arguments:
  args =
Local variables:
  z = 12 hours and 0 minutes
  t = null
```

error occurred in timeConvert()
look at its caller

Finding the call site in main

```
main[2] list
47                  "in San Francisco" + "\n");
48          //   System.out.println((z.timeConvert("Alaska")) +
49          //          "in Alaska");
50              String t = null;
51      =>      System.out.println((z.timeConvert(t)) +
52                  "in San Francisco \n");
53          }
54
55          }
```

Examining Values

```
main[2] print  z
z = 12 hours and 0 minutes
main[2] dump z
z = (UStime)0xee32b210 {
    private int hours = 12
    private int minutes = 0
}
main[2] print t
"t" is not a valid local or class name.
```

variable or object name

hint at source of error

More Navigation

```
main[2] down
main[1] print this
this = 12 hours and 0 minutes
main[1] dump this
this = (UStime)0xee32b210 {
    private int hours = 12
    private int minutes = 0
}
main[1] print s
"s" is not a valid local, class name, or field of (UStime)0xee32b210
main[1] exit
24 remus!111>
```

graceful end of jdb session