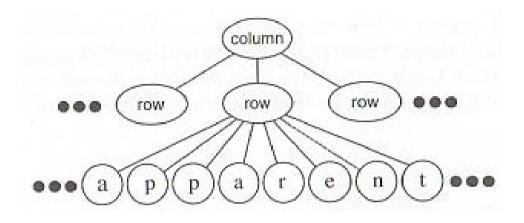
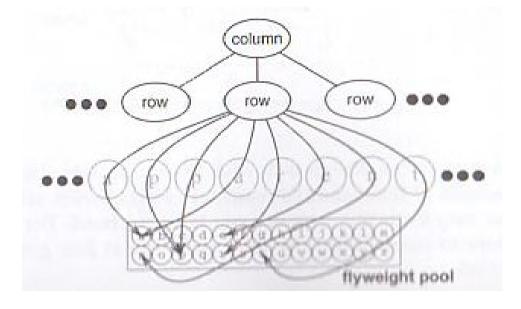
# **Plan for Today**

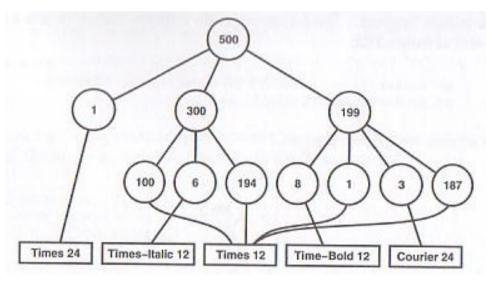
- Template pattern
- Interpreter pattern
- Observer pattern

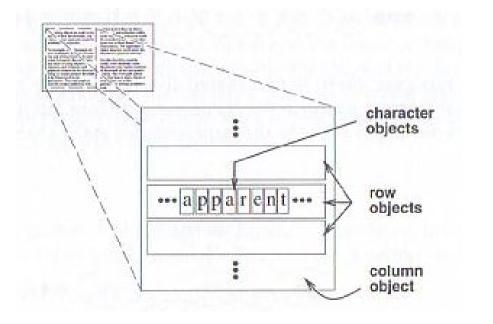
Lecture 52 – 4 December

# Task 7 Questions?



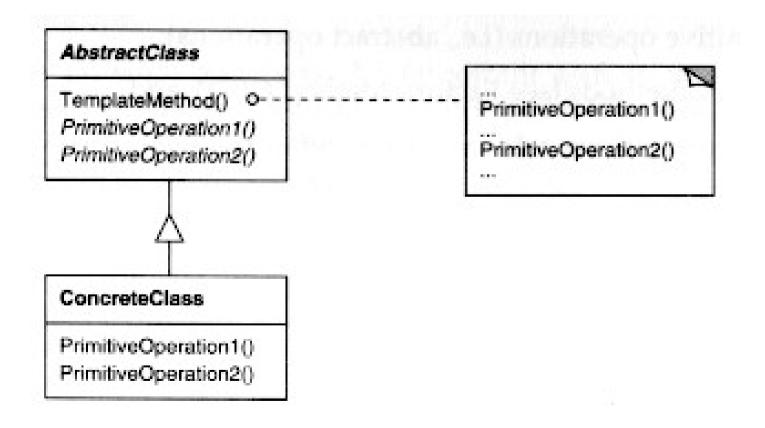






# **Template Pattern**

• Defines skeleton of algorithm in operation, deferring some steps to subclasses. Lets subclasses redefine certain steps of algorithm without changing its structure



# **Template Pattern**

- Informal contract for staging calls to delegated implementations
  - analogous to Command pattern at code level
- Higher-level plug-and-play; e.g., introduction + body + conclusion
  - typical
    - contractually specify behavior on implementation
    - the plug-and-play what (at low "primitive" conceptual access level)
  - template
    - augment typical contract with (runtime) agreement on usage of behavior
    - how the what will be called (at higher "composite" conceptual access level):

```
    _open
    _initialize
    _start
    _run
    _stop
```

6. \_close

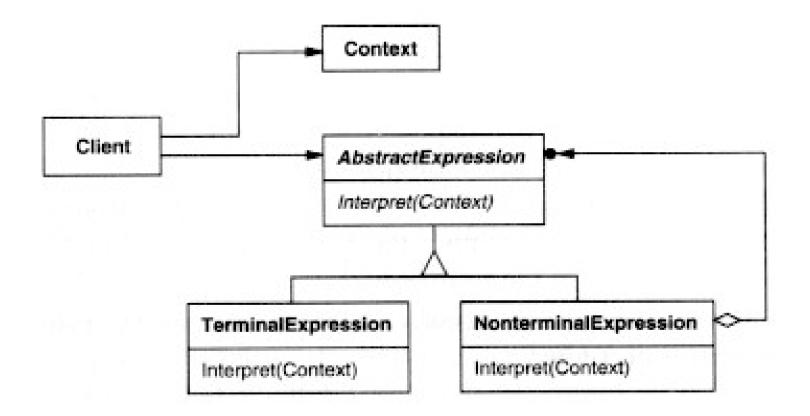
possibly some sharable elements; reduces code duplication

#### **Template Pattern**

Similar to macro:

```
interface I_Viewer {
                               interface I_Document {
                                  I_Document _requestDocument(I_Viewer viewer);
 // macros
                                 void doOpen();
 void _doOpenFile();
                                 void _doRead();
  void _doCloseFile();
                                 void _doRender();
  void _doExit();
                                  void doClose();
 // callbacks / hooks
  void _handleAboutToOpen();
  void _handleOpening(double percentDone);
  void _handleDoneOpening();
}
public class Viewer implements I_Viewer {
  public void doOpenFile() {
    I_Document document = Document._requestDocument(this); // filename?
      document. doOpen();
                           // minimize handling of Document data
      document._doRead();
      document._doRender();
      document._doClose();
                                                    \{ \ldots \} // optional reactions
  public void _handleAboutToOpen()
  public void _handleOpening(double percentDone) { ... }
  public void _handleDoneOpening()
```

• Defines representation based on language/grammar along with decoder that uses representation to interpret sentences in language



```
with field of view 30 power 21 sensitivity 1.5");
evaluate("define sensor radar
                                      SENSOR RADARI
                                                           with field of view 31
evaluate("define sensor thermal
                                      SENSOR THERMAL1
                                                                                           sensitivity 2.5");
evaluate("define sensor acoustic
                                      SENSOR ACOUSTICL
                                                           with
                                                                                           sensitivity 3.5");
evaluate("define sensor sonar active
                                      SENSOR SONARACTIVEL with
                                                                                  power 32 sensitivity 4.5");
evaluate("define sensor sonar passive SENSOR SONARPASSIVE1 with
                                                                                           sensitivity 5.5");
evaluate("define sensor depth
                                      SENSOR DEPTH1
                                                            with
                                                                                                            trigger depth
                                                                                                                              -200"):
evaluate("define sensor distance
                                      SENSOR DISTANCEL
                                                           with
                                                                                                                              20");
                                                                                                            trigger distance
evaluate("define sensor time
                                      SENSOR TIME1
                                                           with
                                                                                                            trigger time
                                                                                                                               23.1");
evaluate("define sensor radar
                                      FUZE RADAR1
                                                         with field of view 32 power 23 sensitivity 10.5");
evaluate("define sensor thermal
                                      FUZE THERMAL1
                                                         with field of view 33
                                                                                         sensitivity 10.5");
                                      FUZE ACOUSTIC1
evaluate("define sensor acoustic
                                                         with
                                                                                         sensitivity 15.5");
                                      FUZE SONARACTIVE1
                                                                                power 34 sensitivity 15");
evaluate("define sensor sonar active
                                                         with
evaluate("define sensor sonar passive FUZE SONARPASSIVEL with
                                                                                         sensitivity 14");
evaluate("define sensor depth
                                      FUZE DEPTH1
                                                         with
                                                                                                          trigger depth
                                                                                                                           - 250"):
evaluate("define sensor distance
                                      FUZE DISTANCEL
                                                         with
                                                                                                                           25");
                                                                                                          trigger distance
evaluate("define sensor time
                                      FUZE TIME1
                                                         with
                                                                                                          trigger time
                                                                                                                            25.1");
evaluate("define munition bomb
                                       MUNITION BOMB1");
evaluate("define munition shell
                                       MUNITION SHELL1");
evaluate("define munition depth charge MUNITION DEPTHCHARGE1
                                                                                               with fuze FUZE ACOUSTIC1");
evaluate("define munition depth charge MUNITION DEPTHCHARGE2
                                                                                               with fuze FUZE SONARACTIVE1"):
evaluate("define munition depth charge MUNITION DEPTHCHARGE3
                                                                                               with fuze FUZE SONARPASSIVEl");
evaluate("define munition depth charge MUNITION DEPTHCHARGE4
                                                                                               with fuze FUZE DEPTH1");
                                                                                               with fuze FUZE TIME1");
evaluate("define munition depth charge MUNITION DEPTHCHARGES
evaluate("define munition torpedo
                                       MUNITION TORPEDOL
                                                             with sensor SENSOR ACOUSTICL
                                                                                               fuze FUZE ACOUSTIC1
                                                                                                                        arming time 1.1");
evaluate("define munition torpedo
                                       MUNITION TORPEDO2
                                                             with sensor SENSOR ACOUSTICL
                                                                                               fuze FUZE SONARACTIVEL arming time 1.2");
                                                             with sensor SENSOR ACOUSTIC1
evaluate("define munition torpedo
                                       MUNITION TORPEDO3
                                                                                               fuze FUZE SONARPASSIVEL arming time 1.3");
evaluate("define munition torpedo
                                       MUNITION TORPEDO4
                                                             with sensor SENSOR ACOUSTICL
                                                                                               fuze FUZE DISTANCE1
                                                                                                                        arming time 1.4");
evaluate("define munition torpedo
                                       MUNITION TORPEDOS
                                                             with sensor SENSOR ACOUSTICL
                                                                                               fuze FUZE TIME1
                                                                                                                        arming time 1.5");
evaluate("define munition torpedo
                                       MUNITION TORPEDO6
                                                             with sensor SENSOR SONARACTIVEL
                                                                                               fuze FUZE ACOUSTIC1
                                                                                                                        arming time 2.1");
evaluate("define munition torpedo
                                       MUNITION TORPEDO7
                                                             with sensor SENSOR SONARACTIVEL
                                                                                               fuze FUZE SONARACTIVEL arming time 2.2");
                                                             with sensor SENSOR SONARACTIVE1
evaluate("define munition torpedo
                                       MUNITION TORPEDOS
                                                                                               fuze FUZE SONARPASSIVEL arming time 2.3");
evaluate("define munition torpedo
                                       MUNITION TORPEDO9
                                                             with sensor SENSOR SONARACTIVEL
                                                                                               fuze FUZE DISTANCEL
                                                                                                                        arming time 2.4");
evaluate("define munition torpedo
                                       MUNITION TORPEDOLO
                                                             with sensor SENSOR SONARACTIVEL fuze FUZE TIMEL
                                                                                                                        arming time 2.5");
                                                             with sensor SENSOR SONARPASSIVEL fuze FUZE ACOUSTICL
evaluate("define munition torpedo
                                       MUNITION TORPEDO11
                                                                                                                        arming time 3.1");
evaluate("define munition torpedo
                                       MUNITION TORPEDO12
                                                             with sensor SENSOR SONARPASSIVE1 fuze FUZE SONARACTIVE1 arming time 3.2");
evaluate("define munition torpedo
                                       MUNITION TORPEDO13
                                                             with sensor SENSOR SONARPASSIVE1 fuze FUZE SONARPASSIVE1 arming time 3.3");
evaluate("define munition torpedo
                                       MUNITION TORPEDO14
                                                             with sensor SENSOR SONARPASSIVEL fuze FUZE DISTANCEL
                                                                                                                        arming time 3.4");
                                                                                                                        arming time 3.5"):
evaluate("define munition torpedo
                                       MUNITION TORPEDO15
                                                             with sensor SENSOR SONARPASSIVEL fuze FUZE TIMEL
evaluate("define munition missile
                                       MUNITION MISSILE1
                                                             with sensor SENSOR RADARL
                                                                                          fuze FUZE RADARl
                                                                                                           arming distance l");
                                                                                          fuze FUZE THERMAL1 arming distance 2");
evaluate("define munition missile
                                                             with sensor SENSOR RADAR1
                                       MUNITION MISSILE2
evaluate("define munition missile
                                       MUNITION MISSILE3
                                                             with sensor SENSOR THERMAL1 fuze FUZE RADAR1 arming distance 3");
evaluate("define munition missile
                                       MUNITION MISSILE4
                                                             with sensor SENSOR THERMAL1 fuze FUZE THERMAL1 arming distance 4");
evaluate("define airplane ACTOR AIRPLANE1 with munition (MUNITION BOMB1 MUNITION SHELL1 MUNITION DEPTHCHARGE1 MUNITION DEPTHCHARGE2 "+
         "MUNITION DEPTHCHARGE3"MUNITION DEPTHCHARGE4 MUNITION DEPTHCHARGE5 MUNITION TORPEDO1 MUNITION TORPEDO2 MUNITIŌN TORPEDO3 "+
         "MUNITION TORPEDO4 "+ MUNITION TORPEDO5 MUNITION TORPEDO6 MUNITION TORPEDO7 MUNITION TORPEDO8 MUNITION TORPEDO9 MUNITION TORPEDO9 MUNITION TORPEDO10 "+
         "MUNITION TORPEDO11 MUNITION TÖRPEDO12 MUNITION TORPEDO13 MUNITION TORPEDO14 MUNITION TORPEDO15 MUNITIÖN MISSILE1 MUNITIÖN MISSILE2 "+
         "MUNITION MISSILE3 MUNITION MISSILE4)");
evaluate("create actor MY AIRPLANEL from ACTOR AIRPLANEL at 49*39'30#/117*25'33#/0 with course 300 speed 100");
                                  from ACTOR SHIP1
                                                           at 49*39'31#/117*25'34#/0 with course 301 speed 101");
evaluate("create actor MY SHIP1
```

evaluate("create actor MY SUBMARINE1 from ACTOR SUBMARINE1 at 49\*39'32#/117\*25'35#/0 with course 302 speed 102");

```
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of many then depth of mago work for the many than the man
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        -- Carrier Actor Airplane text="define airplane ACTOR AIRPLANE1 with munition (MUNITION BOMB1 MUNITION SHELL1
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- « Canada Banana Banana office hard, the factor was promised the PASO_BONA RACHINGS with proceed on a dividy 15" b
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                                                                    < renter-id> PASI SONA RACTIVEL </renter-id
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      MUNITION DEPTHCHARGE5 MUNITION TORPEDO1 MUNITION TORPEDO2 MUNITION TORPEDO3 MUNITION TORPEDO4
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e papas (20 e/papas
e rentalista (20 e/papas)
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                                                              MUNITION TORPEDO10 MUNITION TORPEDO11 MUNITION TORPEDO12 MUNITION TORPEDO13 MUNITION TORPEDO14
                                      of the size of the materials and the color of the size of the size
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      MUNITION TORPEDO15 MUNITION MISSILE1 MUNITION MISSILE2 MUNITION MISSILE3 MUNITION MISSILE4)">
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           <actor-id> ACTOR AIRPLANE1 </actor-id>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             -<munitions>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             -<CarrierMunitionBomb text="define munition bomb MUNITION BOMB1">
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 <munition-id> MUNITION BOMB1 

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                                    Change Common depth of any or common depth of the common depth of 
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 -<CarrierMunitionShell text="define munition shell MUNITION SHELL1">
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   <munition-id> MUNITION SHELL1 </munition-id>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   <munition-shell/>
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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               </CarrierMunitionShell>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 -<CarrierMunitionDepthCharge text="define munition depth charge MUNITION DEPTHCHARGE1 with fuze FUZE ACOUSTIC1">
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   <munition-id> MUNITION DEPTHCHARGE1 </munition-id>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 -<munition-depth-charge>
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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   -<CarrierMunitionDepthCharge text="define munition depth charge MUNITION DEPTHCHARGE2 with fuze FUZE SONARACTIVE1">

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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   -<fuze>
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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          <sensor-id> FUZE SONARACTIVE1 </sensor-id>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        -<sensor-sonar-active>
                                            of Outbourness and Control of Manager (Manager Control of Manager Cont
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            <power> 34.0 </power>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            <sensitivity> 15.0 </sensitivity>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        </sensor-sonar-active>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        </CarrierSensorSonarActive>
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```
-<CarrierActorAirplane text="define airplane ACTOR AIRPLANE1 with munition (MUNITION BOMB1 MUNITION SHELL1
MUNITION DEPTHCHARGE1 MUNITION DEPTHCHARGE2 MUNITION DEPTHCHARGE3 MUNITION DEPTHCHARGE4
MUNITION DEPTHCHARGE5 MUNITION TORPEDO1 MUNITION TORPEDO2 MUNITION TORPEDO3 MUNITION TORPEDO4
MUNITION TORPEDO5 MUNITION TORPEDO6 MUNITION TORPEDO7 MUNITION TORPEDO8 MUNITION TORPEDO9
MUNITION TORPEDO10 MUNITION TORPEDO11 MUNITION TORPEDO12 MUNITION TORPEDO13 MUNITION TORPEDO14
MUNITION TORPEDO15 MUNITION MISSILE1 MUNITION MISSILE2 MUNITION MISSILE3 MUNITION MISSILE4)">
  <actor-id> ACTOR AIRPLANE1 </actor-id>
 -<munitions>
   -<CarrierMunitionBomb text="define munition bomb MUNITION BOMB1">
     <munition-id> MUNITION BOMB1 </munition-id>
      <munition-bomb/>
    </CarrierMunitionBomb>
  -<CarrierMunitionShell text="define munition shell MUNITION SHELL1">
     <munition-id> MUNITION SHELL1 </munition-id>
     <munition-shell/>
    </CarrierMunitionShell>
  -<CarrierMunitionDepthCharge text="define munition depth charge MUNITION DEPTHCHARGE1 with fuze FUZE ACOUSTIC1">
     <munition-id> MUNITION DEPTHCHARGE1 </munition-id>
    -<munition-depth-charge>
      -<fuze>
       -<CarrierSensorAcoustic text="define sensor acoustic FUZE ACOUSTIC1 with sensitivity 15.5">
          <sensor-id> FUZE ACOUSTIC1 </sensor-id>
         -<sensor-acoustic>
            <sensitivity> 15.5 </sensitivity>
          </sensor-acoustic>
         </CarrierSensorAcoustic>
       </fuze>
     </munition-depth-charge>
    </CarrierMunitionDepthCharge>
  -<CarrierMunitionDepthCharge text="define munition depth charge MUNITION DEPTHCHARGE2 with fuze FUZE SONARACTIVE1">
     <munition-id> MUNITION DEPTHCHARGE2 </munition-id>
    -<munition-depth-charge>
      -<fuze>
       -<CarrierSensorSonarActive text="define sensor sonar active FUZE SONARACTIVE1 with power 34 sensitivity 15">
          <sensor-id> FUZE SONARACTIVE1 </sensor-id>
         -<sensor-sonar-active>
            <power> 34.0 </power>
            <sensitivity> 15.0 </sensitivity>
          </sensor-sonar-active>
         </CarrierSensorSonarActive>
       </fuze>
     </munition-depth-charge>
    </CarrierMunitionDepthCharge>
```

```
"define munition bomb MUNITION BOMB1"
"define airplane ACTOR AIRPLANE1 with munition (MUNITION BOMB1)"
"create actor MY AIRPLANE1 from ACTOR AIRPLANE1 at 49*39'30#/117*25'33#/1000 with
 course 300 speed 100"
"set MY AIRPLANE1 load munition MUNITION BOMB1"
"set MY AIRPLANE1 deploy munition MY AIRPLANE1.MUNITION BOMB1"
<CarrierActorAirplane text="define airplane ACTOR AIRPLANE1 with munition (MUNITION BOMB1)">
 <actor-id>
  ACTOR AIRPLANE1
 </actor-id>
 <munitions>
  <CarrierMunitionBomb text="define munition bomb MUNITION BOMB1">
   <munition-id>
    MUNITION BOMB1
   </munition-id>
   <munition-bomb/>
  </CarrierMunitionBomb>
 </munitions>
</CarrierActorAirplane>
```

```
"define sensor acoustic FUZE ACOUSTIC1 with sensitivity 15.5"
"define munition depth charge MUNITION DEPTHCHARGE1 with fuze FUZE ACOUSTIC1"
"define airplane ACTOR AIRPLANE1 with munition (MUNITION DEPTHCHARGE1)"
"create actor MY AIRPLANE1 from ACTOR AIRPLANE1 at 49*39'30#/117*25'33#/1000
with course 300 speed 100"
"set MY AIRPLANE1 load munition MUNITION DEPTHCHARGE1"
"set MY AIRPLANE1 deploy munition MY AIRPLANE1.MUNITION DEPTHCHARGE1"
<CarrierActorAirplane text="define airplane ACTOR AIRPLANE1 with munition (MUNITION DEPTHCHARGE1)">
 <actor-id>
  ACTOR AIRPLANE1
</actor-id>
 <munitions>
 <CarrierMunitionDepthCharge text="define munition depth charge MUNITION DEPTHCHARGE1 with fuze FUZE ACOUSTIC1">
   <munition-id>
   MUNITION DEPTHCHARGE1
   </munition-id>
   <munition-depth-charge>
    <fuze>
     <CarrierSensorAcoustic text="define sensor acoustic FUZE ACOUSTIC1 with sensitivity 15.5">
      <sensor-id>
       FUZE ACOUSTIC1
      </sensor-id>
      <sensor-acoustic>
       <sensitivity>
        15.5
       </sensitivity>
      </sensor-acoustic>
     </CarrierSensorAcoustic>
    </fuze>
   </munition-depth-charge>
```

```
"define sensor acoustic SENSOR ACOUSTIC1 with sensitivity 3.5"
"define sensor acoustic FUZE ACOUSTIC1 with sensitivity/15.5"
"define munition torpedo MUNITION TORPEDO1 with sensor SENSOR ACOUSTIC1
 fuze FUZE ACOUSTIC1 arming time/1.1"
"define airplane ACTOR AIRPLANE1 with munition (MUNITION TORPEDO1)"
"create actor MY AIRPLANE1 from ACTOR AIRPLANE1 at 49*39'30#/117*25'33#/1000
 with course 300 speed 100"
"set MY AIRPLANE1 load munition MUNITION TORPEDO1"
"set MY AIRPLANE1 deploy munition MY/AIRPLANE1.MUNITION TORPED01"
<CarrierActorAirplane text="define/airplane ACTOR_AIRPLANE1 with munition (MUNITION TORPEDO1)">
<actor-id>
 ACTOR AIRPLANE1
</actor-id>
 <munitions>
 <CarrierMunitionTorpedo text="define munition torpedo MUNITION_TORPEDO1 with sensor SENSOR_ACOUSTIC1 fuze FUZE_ACOUSTIC1 arming time 1.1">
  <munition-id>
   MUNITION_TORPED01
  </munition-id>
  <munition-torpedo>
   <sensor>
    <CarrierSensorAcoustic text="define sensor acoustic SENSOR ACOUSTIC1 with sensitivity 3.5">
     <sensor-id>
      SENSOR ACOUSTIC1
     </sensor-id>
     <sensor-acoustic>
      <sensitivity>
       3.5
      </sensitivity>
     </sensor-acoustic>
    </CarrierSensorAcoustic>
   </sensor>
   <fuze>
    <CarrierSensorAcoustic text="define sensor acoustic FUZE ACOUSTIC1 with sensitivity 15.5">
     <sensor-id>
      FUZE ACOUSTIC1
     </sensor-id>
     <sensor-acoustic>
      <sensitivity>
       15.5
```

</sensitivity>

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#### • Old task

- spaceship controller language:

Command	Field 2	Field 3	Field 4	Field 5	Description
Α	id	x	у	angle	adds spaceship $id$ at position $x,y$ with orientation $angle$
D	id				removes spaceship id
S	id	state			brings spaceship $id$ online for $state\ B$ or takes it offline for $state\ T$
L	id				rotates spaceship id counterclockwise one step
R	id				rotates spaceship id clockwise one step
Т	id				thrusts spaceship <i>id</i> forward one unit
I	count				idles count ticks
conti conti conti	roller roller roller		ite("A ite("R ite("L ite("T	dog"; cat"; dog";	); );
		.execu	• • • • • • • • • • • • • • • • • • • •		

- Textbook
  - read readable parts of pages 243-255
  - skim over syntax trees
    - CS481 Compilers and Lexical Analysis
    - simpler implementations possible

- Conventional behavioral control
  - method calls
    - direct ("wired")
    - indirect ("wireless")
  - one-to-one mapping: one method per unit of functionality
- Interpreter pattern
  - complex "portal" adapter
  - many-to-one mapping: one method for all (most) units of functionality
  - miniature command language
    - conventional: lamp.setBrightness(5);
    - interpreter: lamp.execute("set brightness 5");

decouples network protocol

pros: very flexible and extensible; compile-time validation cons: additional complexity and overhead; run-time validation

- Highly useful plug-and-play pattern
  - powerful
  - flexible
  - adaptable
  - extensible
- Consider contemporary games
  - command-line interface
  - bots, cheats, codes, cons, console enhancements, DLLs, drivers, expansion packs, exploits, hacks, maps, mods, patches, rigging, tampering, tweaks, upgrades, wads, looking at my screen
- Decoupled control
  - command-abstraction language
  - widely varying input devices
  - reproducibility in testing

- Implementation
  - customary order
    - 1. syntax: what a command says
    - 2. semantics: what a command means
  - opposite order more appropriate here
    - semantics first: what do we want to convey?
    - syntax last: how should we convey it?
      - simple and easy
      - complex and hard (see book discussion)

• Later lab uses flexible string-based representation (without arguments):

```
public static final String COMMAND_TURN_ON
                                                   = "turn-on";
public static final String COMMAND_TURN_OFF
                                                 = "turn-off";
public static final String COMMAND_REPORT_ON = "report-on";
public static final String COMMAND_REPORT_ON_RESULT = "report-on-result";
public void _receive(Message message) throws NetworkError {
 super._receive(message);
 String command = message.getCommand();
 if (command.equals(COMMAND_TURN_ON)) {
   _basicLamp._turnOn();
 else if (command.equals(COMMAND_TURN_OFF)) {
   _basicLamp._turnOff();
 else if (command.equals(COMMAND_REPORT_ON)) {
   _networkController._transmit(
      new Message(COMMAND_REPORT_ON_RESULT, (""+_basicLamp._isOn()));
```

Could include basic arguments

```
- turn (on|off)
 turn on
  • turn off
- set (brightness|color) <integer_percent>
 • set brightness 0
  • set brightness 50
 • set brightness 100
 set color 5
  • set color 75
 where <integer_percent> 0 0 100
 String s = "set brightness 50";
 String[] fields = s.split(" "); // fields delimited by space
 for (String field : fields) {
   System.out.println(field); // remember Integer.parseInt()?
 any issues?
```

- Grammatical considerations
  - fixed vs. freeform
    - fixed: split fine for rigidly defined grammars (no human involved)
    - freeform: StringTokenizer better

```
StringTokenizer t = new StringTokenizer(s);
while (t.hasMoreTokens())
{
   System.out.println(t.nextToken());
}
```

• Could include complex, programmatic arguments

```
- set (brightness|color) <function>
 • set brightness (linear-step 0 50 10)
 where linear-step function:
   <start_value> is initial value
   <end_value> is final value
   <step_per_second> is transition from initial to final value
  where
    <end_value>
              □ 0 □ 100
```