SE 2AA4, CS 2ME3 (Introduction to Software Development)

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19 Modules with External Interaction (H&S Section 7.4) DRAFT

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- Administrative details
- Modules with external interaction
- MIS for GUI module
- MIS for vector space module
- MIS for SWHS

Administrative Details

TBD

Motor

With our current MIS framework, how would you represent calling the access program `toggleMotor` to either turn a motor on or off, depending on its current state?

A. Introduce a state variable `powerOn` of type Boolean

B. Introduce an ADT for a motor type and pass an instance of this type as an argument

C. Return a Boolean that is True if the motor is on and False otherwise

D. We do not currently have a mechanism for this

Modules with External Interaction

- In general, some modules may interact with the environment or other modules
- Environment might include the keyboard, the screen, the file system, motors, sensors, etc.
- Sometimes the interaction is informally specified using prose (natural language)
- Can introduce an environment variable
  - Name, type
  - Interpretation
- Environment variables include the screen, the state of a motor (on, direction of rotation, power level, etc.), the position of a robot

External Interaction Continued

- Some external interactions are hidden
  - Present in the implementation, but not in the MIS
  - Example
    - OS memory allocation calls
    - `import math` for assignments
- External interaction described in the MIS
  - Naming access programs of the other modules
  - Specifying how the other module's state variables are changed
  - The MIS should identify what external modules are used

MIS for GUI Modules

- Could introduce an environment variable
- window: sequence [RES_H][RES_V] of pixelT
  - Where window[r][c] is the pixel located at row r and column c, with numbering zero-relative and beginning at the upper left corner
  - Would still need to define pixelT
- Could formally specify the environment variable transitions
- More often it is reasonable to specify the transition in prose
- In some cases the proposed GUI might be shown by rough sketches

Display Point Masses Module Syntax

Exported Access Programs

Routine name	In	Out	Exc.
DispPointMassesApplet		DispPointMassesApplet	
paint			

Steps

1. DispPointMassessApplet first builds a list of point masses in the ListPointMasses abstract object (the list is explicitly given in the spec)
2. paint then displays the point masses on the screen, as circles with the centre at the coordinates for the point mass and the radius equal to the mass

What external interactions do we have? What environment variables do we need? What if we read the data in from a file?

Display Point Masses Module Semantics

Environment Variables

win : 2D sequence of pixels displayed within a web-browser

DispPointMassesApplet():

- transition: The state of the abstract object ListPointMasses is modified as follows:
  ListPointMasses.init()
  ListPointMasses.add(0, PointMassT(20, 20, 10)
  ListPointMasses.add(1, PointMassT(120, 200, 20)
  ...

paint():

- transition *win* := Modify window so that the point masses in ListPointMasses are plotted as circles. The centre of each circles should be the corresponding x and y coordinates and the radius should be the mass of the point mass.

Vector Space Module

Exported Access Programs

Routine name	**In**	**Out**	**Exceptions**
new vectorT	real $\rightarrow$ real	vectorT	
getf		real $\rightarrow$ real	
eval	real, real, integer	seq of real	deltaNeg, nstepsNeg
evalPrint	real, real, integer		deltaNeg, nstepsNeg

Vector Module Semantics

Environment Variables

screen : two dimensional sequence of positions on the screen, where each position holds a character

State Variables

f: real $\rightarrow$ real

Access Routine Semantics

eval $(startx, deltax, nsteps)$:

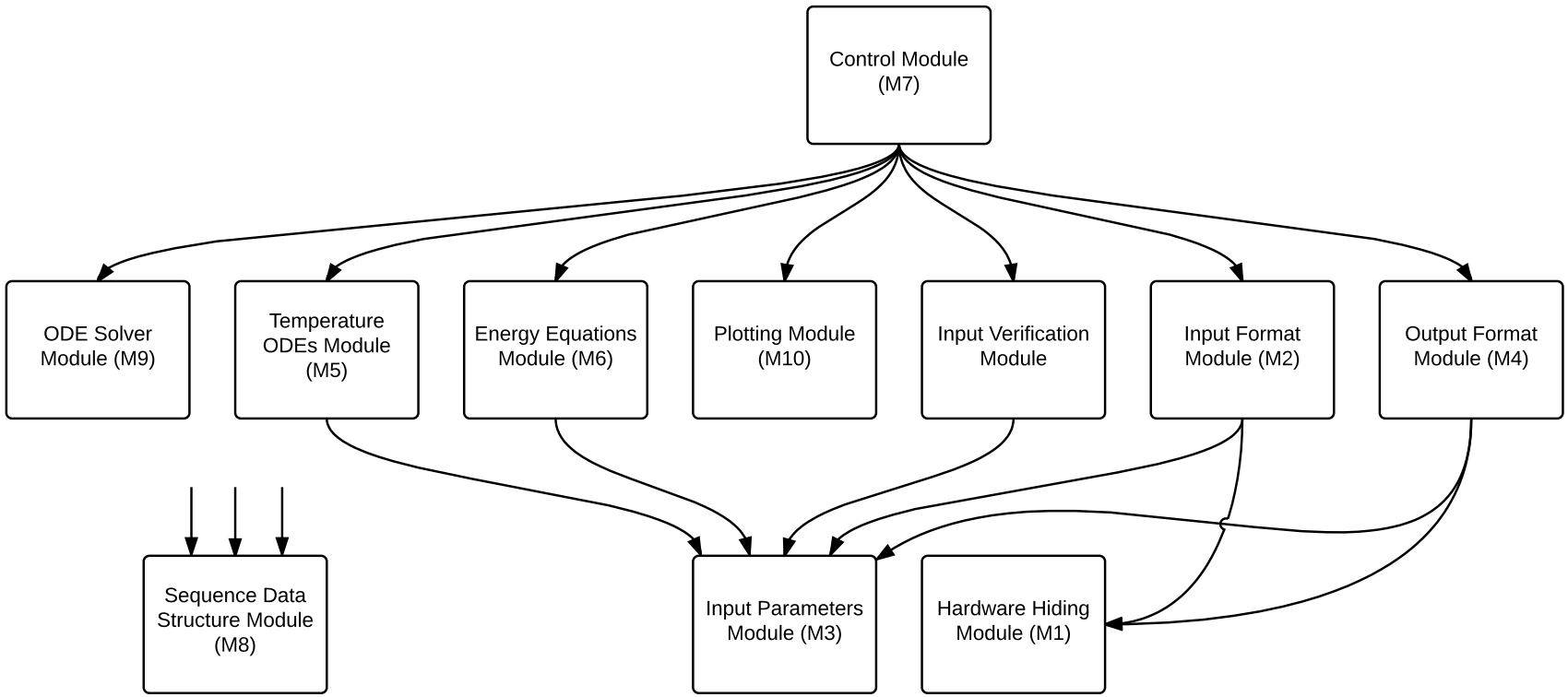
- output: $out :=< f(startx), f(startx + deltax), f(startx + 2 \cdot deltax), ..., f(startx + nsteps \cdot deltax) >$
- exception: $exc := ((deltax < 0) \Rightarrow \text{deltaNeg} | (nsteps < 0) \Rightarrow \text{nstepsNeg})$

Vector Module Semantics Continued

evalPrint (*startx*, *deltax*, *nsteps*):

- transition: The state of *screen* is modified so that the sequence returned by eval (*startx*, *deltax*, *nsteps*) is displayed. All values in the 2D sequence screen will be white space, except for the coordinates screen[x][f(x)], where x corresponds to the horizontal distance across the screen. # *We could also introduce the notion of scaling.*
- exception: $exc := ((deltax < 0) \Rightarrow \text{deltaNeg} | (nsteps < 0) \Rightarrow \text{nstepsNeg})$

SWHS Uses Hierarchy



MIS document