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1   Handout for CS 372H
2   Class 13
3   01 March 2011
4
5   Therac-25
6
7   1. Software problem #1 (our best guess)
8
9       A. Three threads:
10
11          --Hand: sets the collimator/turntable position
12
13          --Treat: sets a bunch of other parameters. Part of its job takes
14          eight seconds, during which time it's ignoring everything else.
15
16          --Vtkbp (keyboard handler): invoked when user types. It parses
17          the input, and writes to a two-byte shared variable, "MEOS" (mode/energy
18          offset)
19              --"Treat" reads top byte, sets current and energy
20              --"Hand" reads bottom byte, sets the collimator/turntable position
21
22      B. Pseudocode:
23
24          Vtkbp (gets and parses keyboard input):
25
26              data_completion_flag = 0
27
28              while (1) {
29                  wait_for_keyboard_activity();
30                  /* there was some keyboard activity; let's check it */
31                  if (cursor_in_bottom_right) {
32                      parse_the_input();
33                      set the MEOS variable
34                      set data_completion_flag = 1;
35                      signal hand thread
36                      signal treat thread
37                  } else {
38                      /* operator still typing */
39                      data_completion_flag = 0;
40                  }
41                  yield();
42              }
43
44
45          Hand (sets the turntable position):
46
47              while (1) {
48                  wait until signalled
49                  read bottom byte of MEOS variable
50                  /* next line executes quickly */
51                  set turntable position
52                  yield();
53              }
54
55          Treat (sets a bunch of parameters and delivers treatment):
56
57              dataent() { /* this is a subroutine that was called */
58
59                  while (1) {
60                      wait until signalled
61                      read top byte of MEOS variable
62                      set_energy_and_current();
63                      set_bending_magnets(); /* this takes eight seconds */
64                      if (data_completion_flag == 1)
65                          break;
66                  }
67                  /*
68                   * now we leave the subroutine and progress to a state in
69                   * which the machine will accept a "beam on" command
70                   */
71                  return;
72              }
73
```

```
74   2. Software problem #2 (simplified)
75
76      [Simplifying here and condensing to one thread of control; in
77      reality, the functions below are spread over two different threads,
78      but that is not actually the problem, despite what the paper
79      sometimes says. The problem appears to be given by the following
80      simplified description.]
81
82      class3 = 0;
83
84      while (1) {
85
86          if (in field light position) {
87              increment class3;
88          }
89
90          check whether operator pressed "set"
91
92          if (operator pressed set) {
93              if (class3 != 0) {
94                  move turntable out of field light mode;
95              }
96              break;
97          }
98      }
99
100     What's the issue here? (Hint: class3 is only one byte.)
101
```
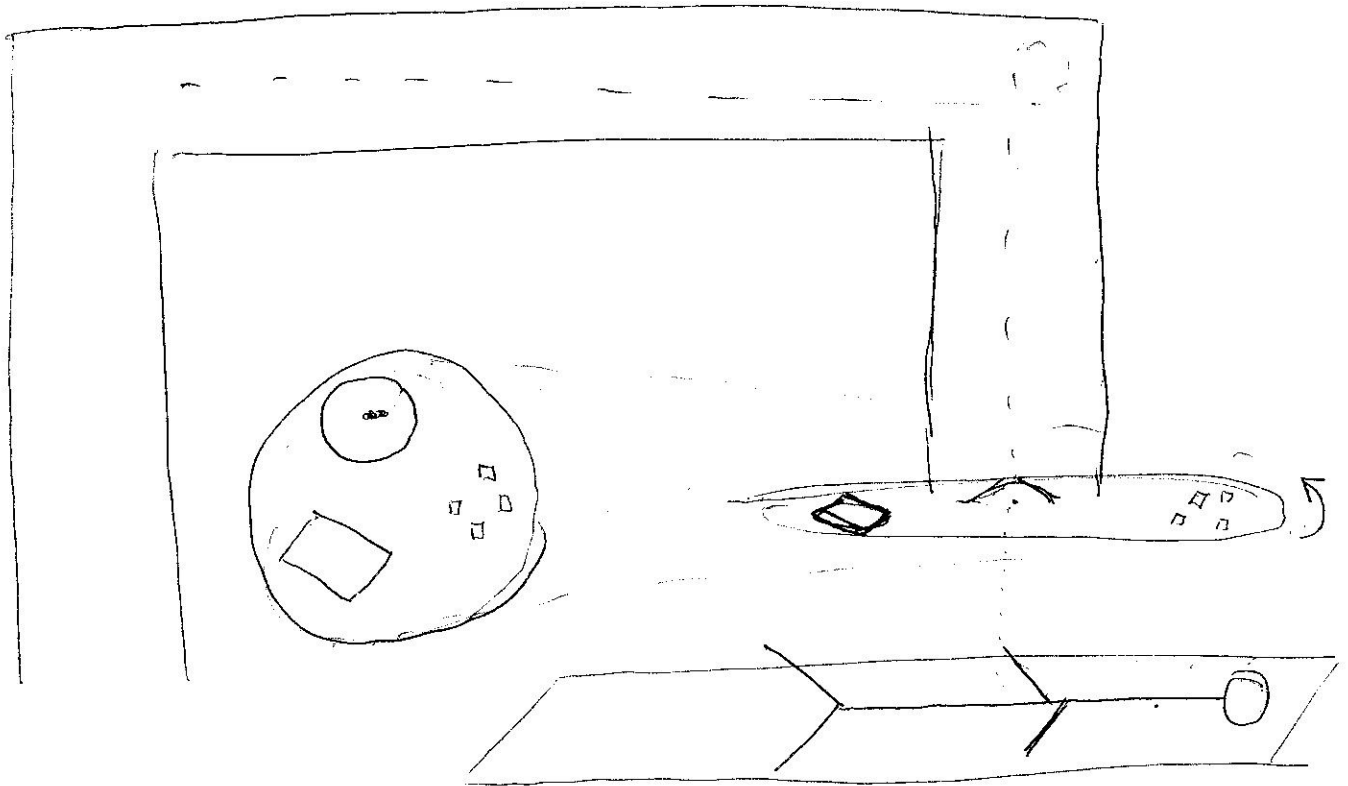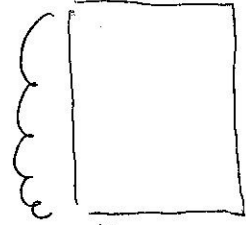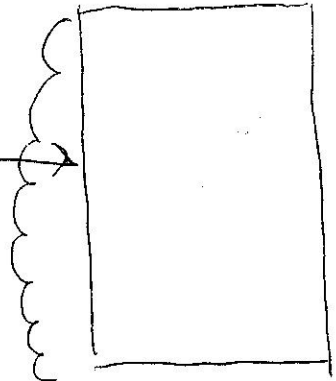
Keyboard Handler (Vtkbp)
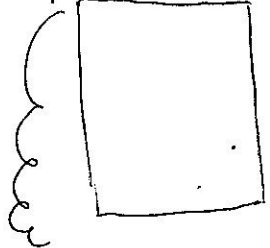
Turntable Thread (Hand)

MEOS
(mode energy offset)

Parameter setting/Treatment (Treat)

- Turntable: rotates the turntable
- Treat: sets magnets, sets energy, sets current