```
1   CS 202, Spring 2015
2   Handout 7 (Class 8)
3
4   Therac-25
5
6   1. Software problem #1 (our best guess)
7
8       A. Three threads:
9
10          --Hand: sets the collimator/turntable position
11
12          --Treat: sets a bunch of other parameters. Part of its job takes
13          eight seconds, during which time it's ignoring everything else.
14
15          --Vtkbp (keyboard handler): invoked when user types. It parses
16          the input, and writes to a two-byte shared variable, "MEOS" (mode/energy
17          offset)
18              --"Treat" reads top byte, sets current and energy
19              --"Hand" reads bottom byte, sets the collimator/turntable position
20
21      B. Pseudocode:
22
23          Vtkbp (gets and parses keyboard input):
24
25              data_completion_flag = 0
26
27              while (1) {
28                  wait_for_keyboard_activity();
29                  /* there was some keyboard activity; let's check it */
30                  if (cursor_in_bottom_right) {
31                      parse_the_input();
32                      set the MEOS variable
33                      set data_completion_flag = 1;
34                      signal hand thread
35                      signal treat thread
36                  } else {
37                      /* operator still typing */
38                      data_completion_flag = 0;
39                  }
40                  yield();
41              }
42
43
44          Hand (sets the turntable position):
45
46              while (1) {
47                  wait until signalled
48                  read bottom byte of MEOS variable
49                  /* next line executes quickly */
50                  set turntable position
51                  yield();
52              }
53
54          Treat (sets a bunch of parameters and delivers treatment):
55
56              dataent() { /* this is a subroutine that was called */
57
58                  while (1) {
59                      wait until signalled
60                      read top byte of MEOS variable
61                      set_energy_and_current();
62                      set_bending_magnets(); /* this takes eight seconds */
63                      if (data_completion_flag == 1)
64                          break;
65                  }
66                  /*
67                   * now we leave the subroutine and progress to a state in
68                   * which the machine will accept a "beam on" command
69                   */
70                  return;
71              }
72
```

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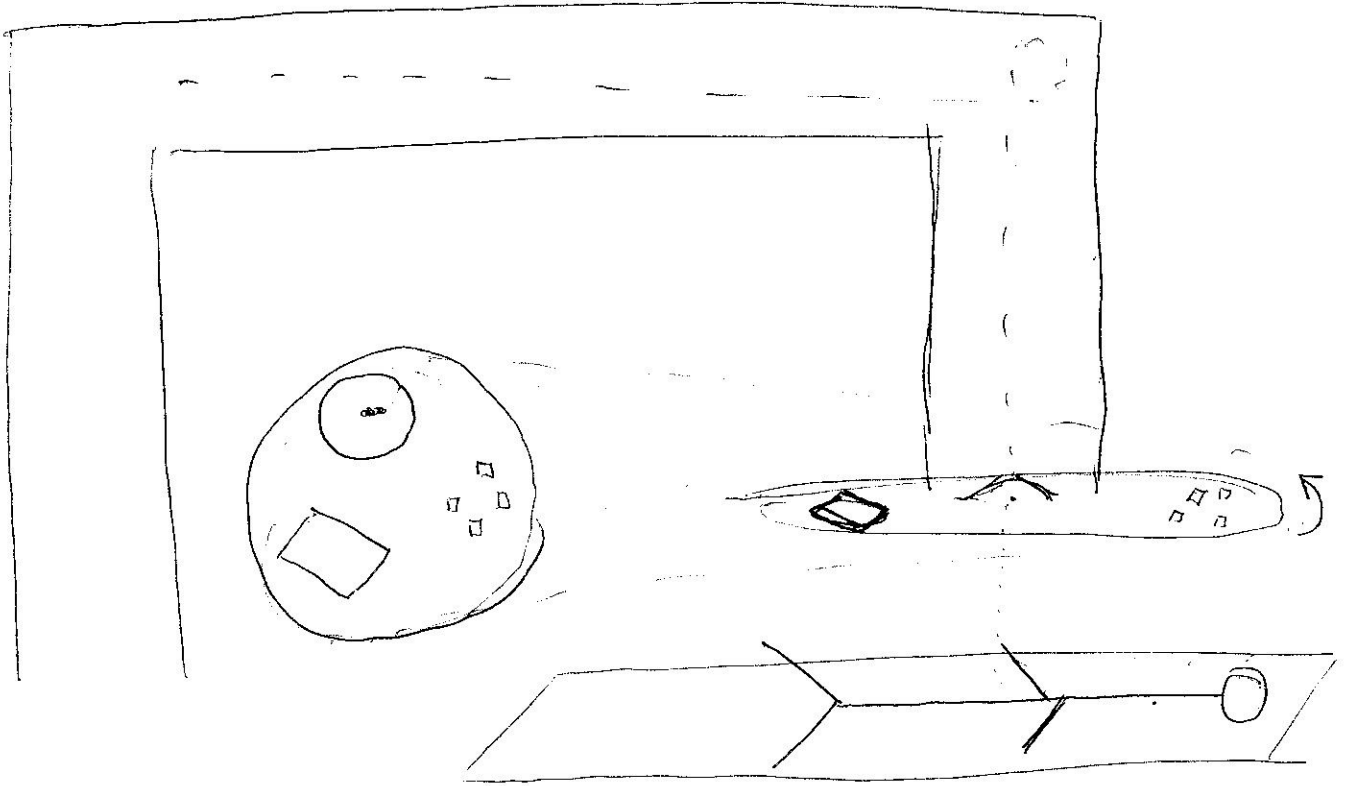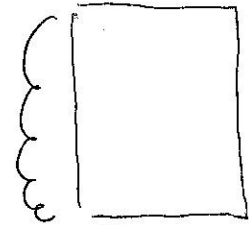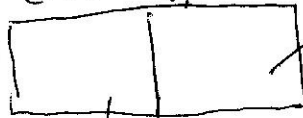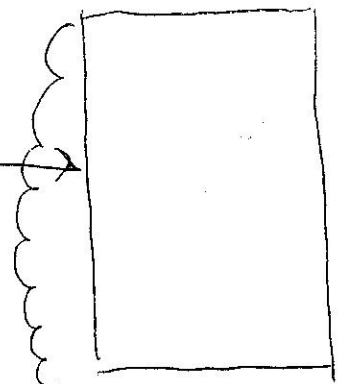
Keyboard Handler (Vtkbp)
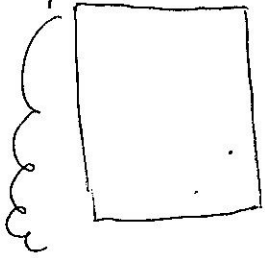
Turntable Thread (Ttard)

MEOS
(mode energy offset)

Parameter setting/Treatment (Treat)

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