

Cs 202 (002) Lecture 10

ANNOUNCEMENTS:

- No class next TUESDAY, OCT 7 (also no office hours Oct 6)
- Scheduling lecture (TUESDAY)
 - Did not cover I/O: today
 - M/FQ: see book, notes

SCHEDULING W/ I/O

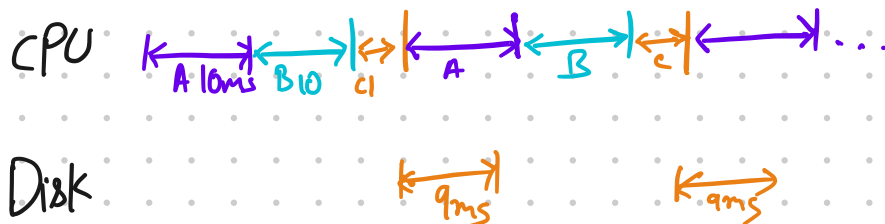
• Reminder: EXPECT Most Tasks To PERFORM I/O — DURING WHICH THEY ARE BLOCKED

Tasks

- | | |
|--------------|---------------------------------------|
| A: CPU Bound | Run for 5 minutes, never block |
| B: CPU Bound | Run for 5 minutes, never block |
| C: I/O Bound | Run for 1ms
Read from disk for 9ms |
- } Total 5min

STCF in this context: Pick based on time on CPU

- Round robin with 10ms quanta

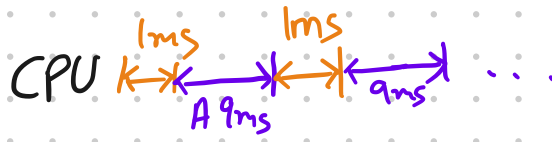


Observe: Disk used 9ms every 21ms
Used $\frac{3}{7} \sim 42\%$

Quantum 100ms

9ms every 201ms $\sim 4.4\%$

STCF



Disk utilization?

9ms $\sim$ 10ms

90%

Things to remember about sched

- METRICS WE CAN OPT.

- TURNAROUND TIME

- RESPONSE TIME

- UTILIZATION

- INPUT

- FAIRNESS

- ...

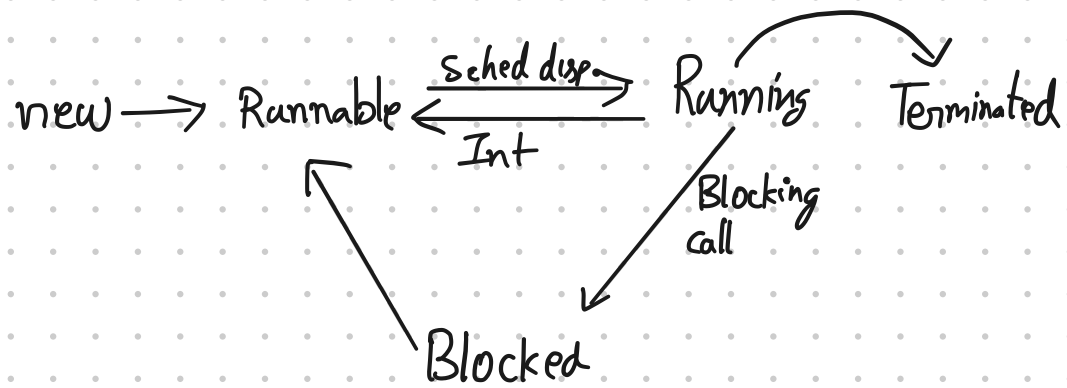
You can compute each of these given a past execution!

- DIFFERENT SCHED. MECH

- FIFO

- MLFQ

- SJF/STCF
- RR (quanta: Time before preempt)
- Stride/lottery
- Process state machine



THERAC-25

Goals - Talk about a **horrible** concurrency bug

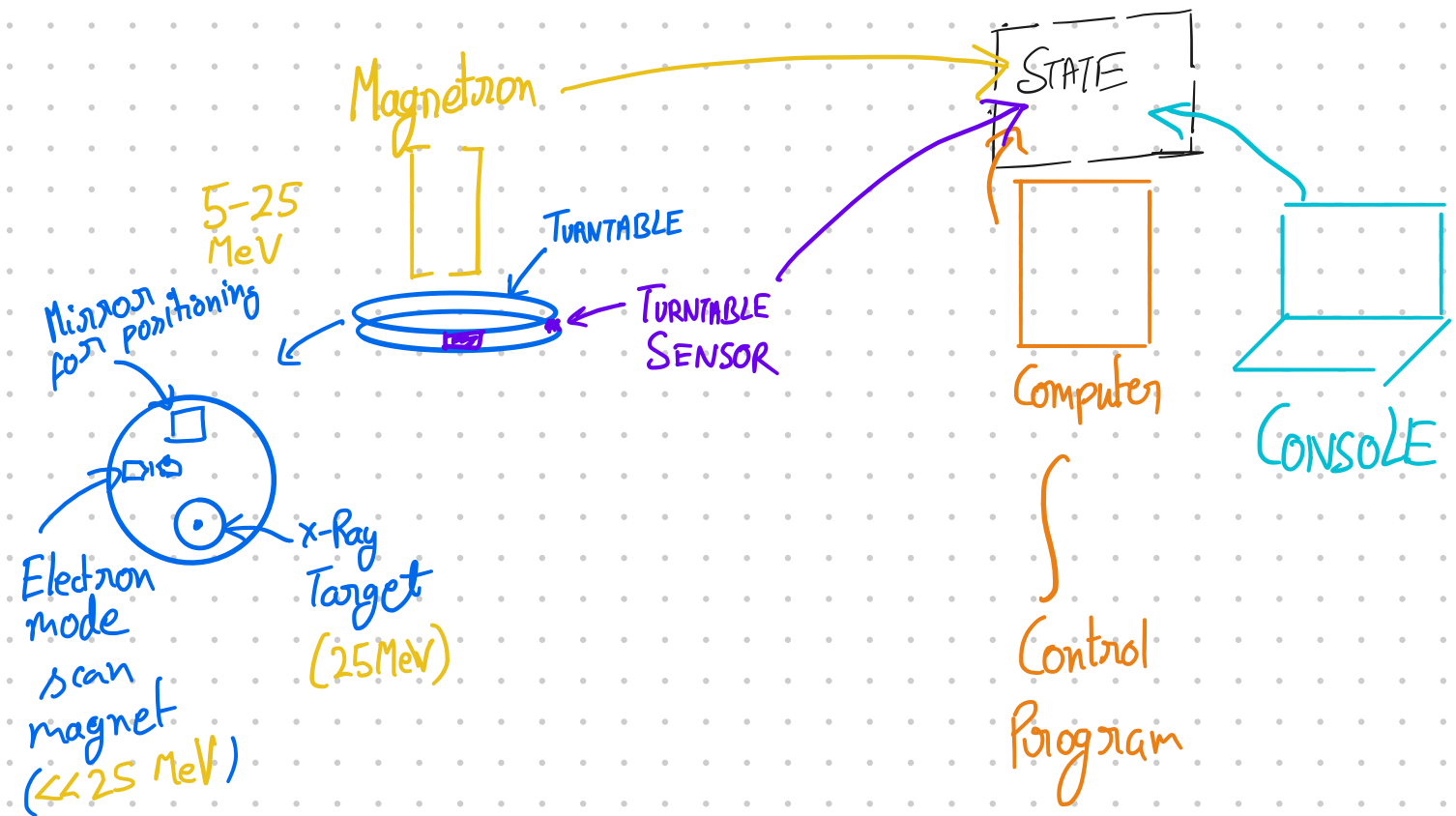
↳ The difficulty of finding problems with tests / runs / etc.

↳ The need to reason about correctness
(with pen & paper, for instance)

- The challenge of debugging concurrent programs
- Think about the ethics of building software
 - ↳ Bugs are inevitable

How do we respond to their discovery?

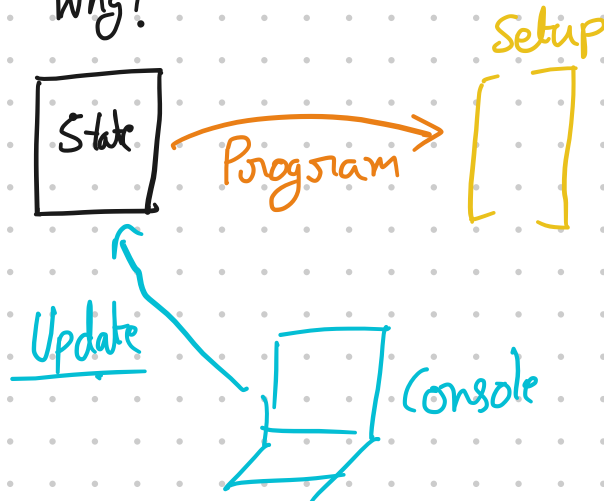
Setup



CONCURRENCY ISSUES (among many)

- (a) Some changes at the console did not have any effect on the machine

Why?



State. Parent

Setup

Console True

Console changed again

Setup

Not noticed

East Texas Cancer Center

(b) Overflow : Int as bool

→ uint8_t

```
class3 = 0;
while (1) {
    if (in field light position) {
        increment class3;
    }

    // check whether operator pressed "set"
    if (operator pressed set) {
        if (class3 != 0) {
            move turntable out of field light position;
        }
        break;
    }
}
```

→ 0, 1, 2, ..., 255, 0

Why implement this way?

- Performance/
Code size

General Problems

- Nothing checking global correctness
+.

requirements

- Field light $\Rightarrow$ No beam
- ! X-ray $\Rightarrow$ Low beam
- X-Ray $\Rightarrow$ Twintable at XRay

...

In previous models (Therac-20) hardw

INTERLOCKS ensured some of these
invariants

Debugging Problems

- Problem reported $\rightarrow$ Cannot Reproduce

$\hookrightarrow$ This is reality, even today.

Why?

Things people have tried

- Crash dumps & reading code to reconstruct
- Logging
- Record-replay, etc.
- ...

But it remains hard.

- Diagnosis took time
- Disclosure - People were sometimes not told. Why?

Lessons?