

CS202 - Scheduling AND Therac - 25

Last class

- METRICS

↳ APP CENTRIC

- TURNAROUND TIME

- OUTPUT TIME

→ SYSTEM CENTRIC

- TPUT

→ FAIRNESS

→ UTILIZATION

- PRE-EMPTIVE & COOPERATIVE SCHEDULING

- POLICIES

- FCFS/FIFO

- SJF/SCTF

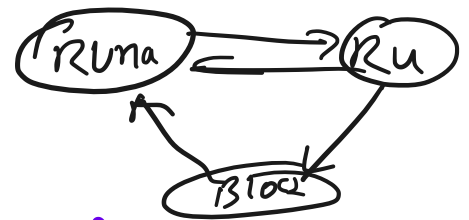
- ROUND ROBIN

- WHERE WE LEFT OFF

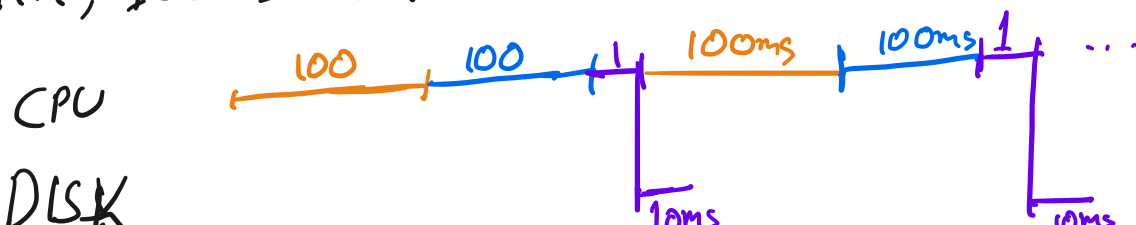
A: CPU BOUND

B: CPU BOUND

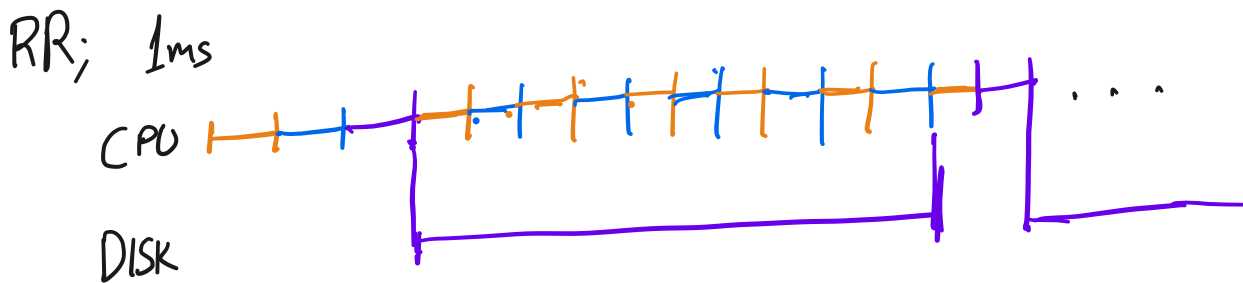
C: 1ms CPU $\xrightarrow[\text{SYSCALL}]{\text{BLOCKING}}$ 10ms DISK



RR, 100ms QUANTA



DISK UTILIZATION: $\frac{10ms}{\sim 201ms}$



Disk Utilization $\frac{10ms}{10 \leq t \leq 12ms} \sim 100\%$

- Observation:
- ① Small quanta better for disk
 - ② Worse in terms of # of context switches.

SCTF, except

↳ Use CPU time as completion time

→ Invoke scheduler whenever

- New process arrives
- Process unblocks
- Quanta expires (100ms)

Process	Completion Time
Running (A)	∞ - 10ms

Blocked

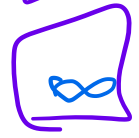
B

~~Blocked~~

C

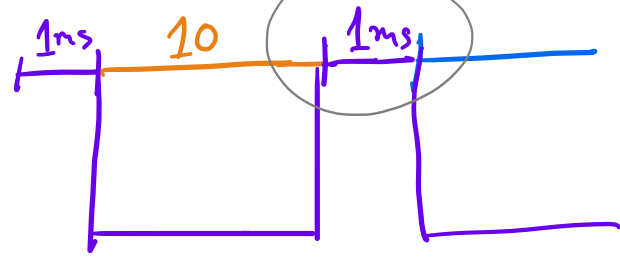
~~Runnable~~

Blocked Observation



1ms

CPU



DISK

- SCTF does better than RR w/
100ms quanta, for
disk utilization

- SCTF does better than
RR w/ 1ms quanta for
context switches.

- BUT NEEDS TO KNOW
COMPLETION TIME?

USE PAST OBSERVATION TO ESTIMATE
Exponential Weighted Moving Average

$$= \sum_{i=0}^{\infty} \alpha^i X_i$$

Quantities

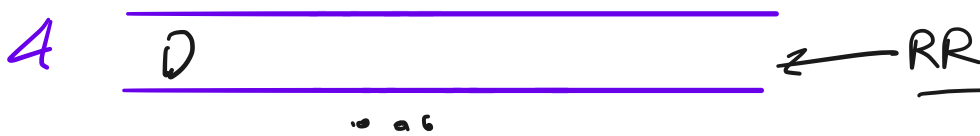
PRIORITIES

THIS IS IMPORTANT / COMMONLY USED

STRICT PRIORITY (HIGHER # BETTER)



ABC
ABC



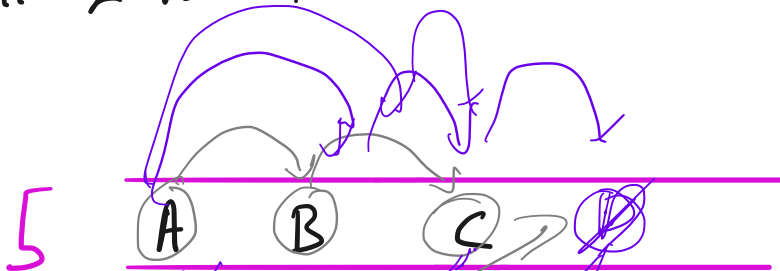
ABC D



PROBLEM WHEN DOES F (PRIORITY=1) RUN?

STARVATION

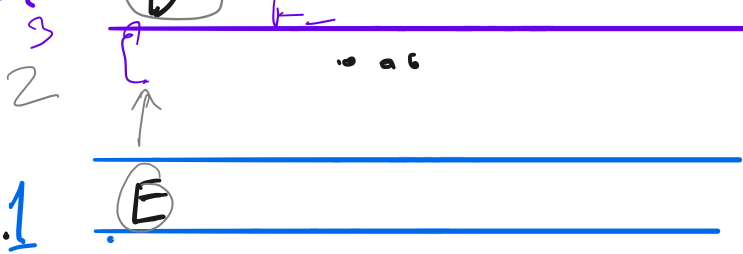
MULTI-LEVEL FEEDBACK QUEUE



ABC ABCD ABC ABCD
ABCE ABC

Goal: Avoid starvation.

How: FEEDBACK



Temporarily boost priority for processes that have not run.

man 1 nice
 10ms
 10ms
 9ms
 1/3 ms 2/3 10ms
 A CPU
 B ~~1ms blocked 5ms~~ 1ms 5ms Block 20ms
 5ms 1ms

Lottery (FS (Linux))

Schedules

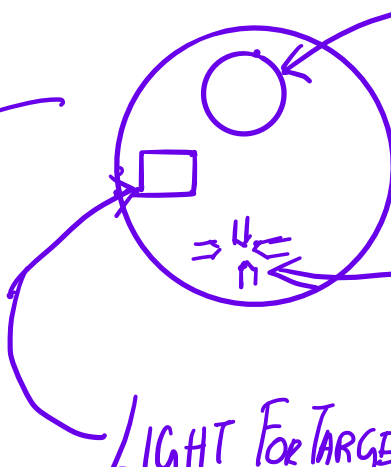
- A 5 tickets
- B 5 tickets
- C 5 tickets
- D 4 tickets
- E 1 ticket

Total tickets = 20

- A :- 1/4 of Time
- B :- 1/4 of Time
- C :- 1/4 of Time
- D :- 1/5 of time
- E :- 1/20 of time

THERAC-25

PRODUCE 0 - 25 MeV Energy



Ion Chamber
25 MeV → X-ray

ELECTROMAGNET
0-25 MeV → "SHAPES BEAM"

LIGHT FOR TARGETTING
0eV → LIGHT

ENERGY LEVEL +
ON OR NOT



SENSOR TO DETECT STATE



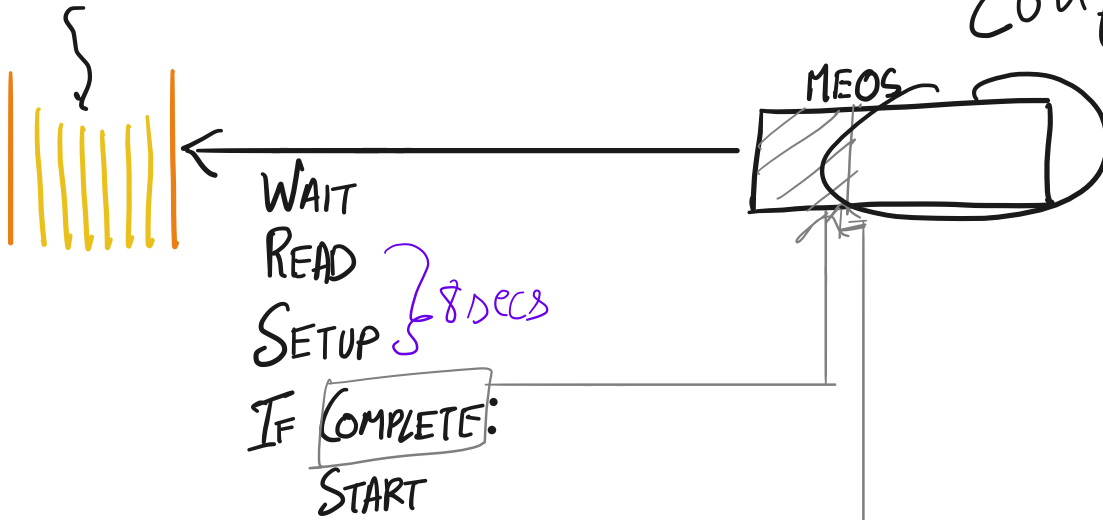
PROBLEM?



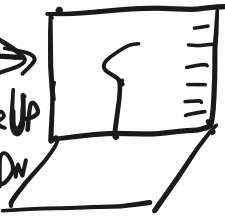
TERMINAL
TO SETUP
TREATMENT

Offset
Mode
Energy

config → local for



UP ← CURSOR UP
DN ← CURSOR DN
...



IF (INPUT VALIDATES)
COMPLETE =
(CURSOR == LAST LINE)

WHY DID IT TAKE SO LONG TO FIGURE IT OUT?

QA difficult & exp.

Concurrency

Inputs needed

Societal expectations

Error code abstract

No documentation

INTERLOCKS???

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