CSE3241: Operating System and System Programming

Class-14

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Necessary Conditions for Deadlock

- A **Deadlock** can arise if the following **four** conditions hold **simultaneouly**:

1. **Mutual Exclusion**: At least one R must be held in a nonsharable mode. It would never happen, $P_i \longleftarrow R \longrightarrow P_{i+1}$ when R is non-sharable.

2. **Hold and Wait**: $R_j \longrightarrow P_i \longrightarrow R_{j+1} \longrightarrow P_{i+1}$.

3. **No Preemption**: R cannot be taken away from P unless it voluntarily realeases.

4. **Circular Wait**: $P_i \longrightarrow R_j \longrightarrow P_{i+1} \longrightarrow R_{j+1} \longrightarrow \; .... \; \longrightarrow P_i$

Methods of Handling Deadlock

- Deadlock can be handled by one of three ways:

1. **Prevent or Avoid**: Take precautions.
2. **Detect and Recover**: At first let deadlock occurs and then take action.
3. **Pretend**: Pretend deadlock will never happen.

How to Pretend: Ostrich Algorithm

Algorithm: Stick your head in the sand and pretend there is no problem at all.

- It is upto application developers to handle deadlocks.
- Mathematicians found it completely unacceptable.
- Many OS engineers love to embrace this algorithm.
- Most operating systems implement it including: UNIX, Linux, Microsoft Windows.

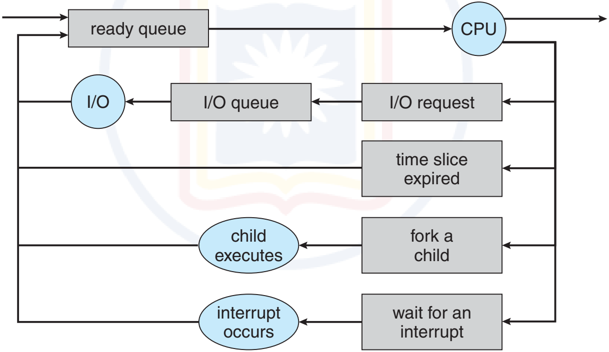
Ostrich Bird [2]

Story of an Unlucky Process Rumor

- An unlucky process:
  - was found when MIT's IBM 7094 was shut down.
  - waited from 1967 to 1973.
  - did not get access of CPU even after waiting for around **7** years.
- The culprit was nobody else but its niceness (i.e., low-priority).
- Moral of the Story: **Too much nicesness is dangerous!!!**
- **Indefinite blocking** or **starvation**: It is a situation, when a process is trapped in the ready queue for the indefinite time.
  - It may badly affect any low-prority process in any system using priority based CPU scheduling.

CPU Scheduler

- CPU scheduler:
  - is the part of OS which selects a process from the ready queue and allocates the CPU to that process.
  - is known as **short-term scheduler**.
  - works when any of the event occurs as shown in the Figure.



[1]

Coarse Classification of CPU Scheduling Algorithm

- CPU scheduling can be:

1. **Preemptive Scheduling**:
   - a running process can be sent back to the ready queue by taking away its allocated CPU.
   - incurs an extra cost associated with access to shared data.
   - may cause extra burden for the OS because of context switch.

2. **Non-Preemptive Scheduling**:
   - onece the CPU is allocated to a process, it keeps the CPU until it realeases the CPU eitherby terminating or by switching to the waiting state.
   - is known as **cooperative scheduling**.

Fine Classification of CPU Scheduling Algorithm

- CPU Scheduling can be:
  1. **First-Come, First-Served (FCFS)**: Process **P** that **requests the CPU first** is allocated the CPU first.
  2. **Shortest-Job-First (FJS)**: Process **P** that requires the **least CPU access** is allocated the CPU first.
  3. **Priority Based (PB)**: Process **P** with the **highest priority** is allocated the CPU first.
  4. **Round-Robin (RR)**: Process **P** is allocated the CPU for **T** time and after that it is put in the **last of the ready queue**.
- All scheduling algorithms except FCFS, can be preemptive and non-preemptive.

Negative Points of Scheduling Algorithm

- FCFS
  - average waiting time of processes is not minimal.
  - cannot make a balance between CPU burst and I/O burst processes
  - not suitable for time sharing systems, since it is non-preemptive.
- SJF:
  - knowing the CPU usage time is advance is impossible.
- PB
  - indefinite blocking or starvation.
- RR:
  - average waiting time of processes is often long.
  - burden of context switching.

References

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