COMP0020 Functional Programming

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What is Dynamic Memory Management (DMM) ?

- Problem to be solved : (i) don't know until run-time what memory will be needed ; and (ii) desire to re-use memory locations (memory is a scarce resource)
- Problem to be solved : required blocks of
- A solution : write a Storage Manager (S ree"
- Give malloc the size of memory required, it returns a pointer
- Give free a pointer to a block that is not longer required, it makes it avail
- The library functions will manage the differently-sized blocks of "live" and "free' memory in an optimal way

What is AMM ?

- Biggest source of bugs : POINTERS
- A solution :
  - Don't let programmers have dire S)
  - Let system manage memory allocation/deallocation
  - Functional languages, Java
- An onerous responsibility for the system
  - must never go wrong

How does AMM work ?

- Just like DMM, a storage manager (SM) subroutine services requests from the rest of the program
  - Program (runtime system) requ
  - SM :
    - ★ searches for appropriate chu
    - ★ Allocates the chunk (tags it "in use" or "live")
    - ★ returns a pointer to that chunk
  - Programmer never sees the pointer – only used by runtime system
- SM detects when "in use" chunk becomes garbage and tags it "free"

How does AMM work? (2)

- Memory allocation techniques
  - Which chunk (block) of memory s s it matter?
- Garbage collection techniques
  - How to identify garbage
  - How to collect garbage
- Compaction/defragmentation techniques
  - How does fragmentation occur
  - How can it be reduced or removed

Issues : Garbage collection

- How is garbage created ?
  - Beta reduction, delta reduction ..
- How is garbage identified ?
  - Number of references ? ... or conne
- How is garbage collected ?
  - Use a free list ? ... or not
- How is garbage reused ?
  - Cooperation with memory allocation

Issues : how much does it cost ?

- Time
  - Performance degradation
  - Embarrassing pause ?
    - ⋆ Real-time systems ?
- Space
  - Some memory set aside for administration ?
  - Some extra memory required per cell ?
  - Size of code ?

Issues : fragmentation

- What is it ?
- Why is it a problem ?
  - Embedded systems
  - Virtual memory - paging overhea
- How can it be solved ?
  - Coalescing
  - Compaction :
    - Copying
    - Sliding

Summary

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  - Programmer control vs system co
  - Reuse/recycling of memory
- How does AMM work ?
  - Memory allocation
  - Garbage collection
- Issues
  - How is garbage created, detected, reused ?
  - What overheads do we incur ? (space/time)
  - Fragmentation