

REVIEW: TOP DOWN DESIGN

Introduction:

Algorithm Design

Machine Model – Random Access Machine

Time and Time Complexity – Cost Models

1

COURSE MOTIVATION

○ Solving Problems

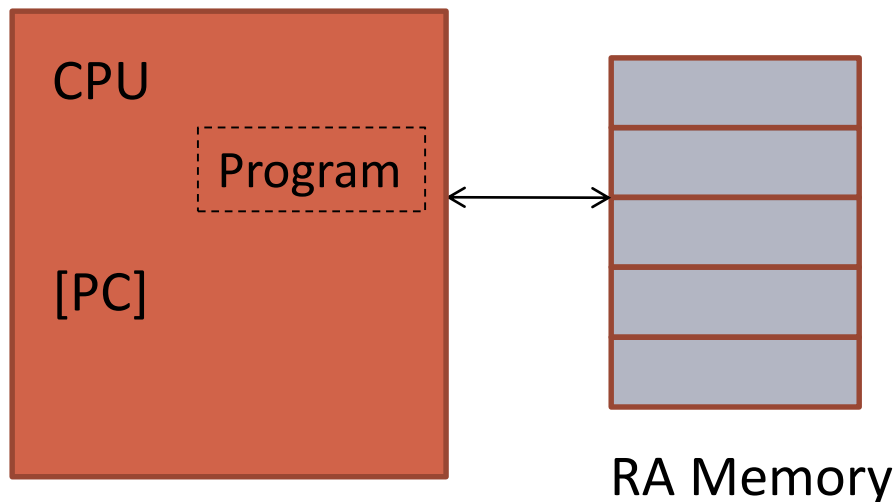
- Requires writing Programs (“Concrete solutions”)
 - Solve one specific problem i.e. for a class of inputs
 - That can run on one specific language/platform

○ Writing Programs

- Requires designing Algorithms (“abstract solutions”)
 - May solve a class of problems
 - Solution not dependent on specific language/platform

ALGORITHM DESIGN – MACHINE MODEL

- High level Specification
 - i.e. independent of specific machines/machine architectures and/or specific language constructs
- Generic Machine Model
 - Random Access Machine Model

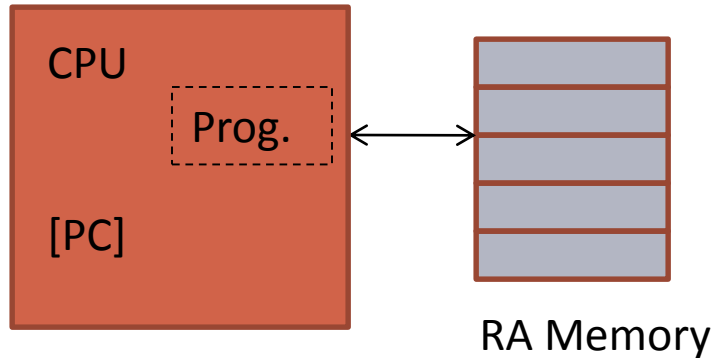


What does Random Access mean?

What is the cost of accessing a location?

RANDOM ACCESS MACHINE MODEL

- Generic Machine Model
 - Random Access Machine Model



Typical Instruction Set

Instructions for

- arithmetic/logic operations,
- memory access (load / store) and
- control (**jmp** / **br**)

- Instructions operate on single memory words (or registers of same size).

- **Q:** Why is this relevant?

- **Hint:** How many operations are required for $a+b$? E.g. $a=10^{20}$ $b=10^{22}$

RAM MODEL – COST MODELS

○ Uniform Cost Model:

- Cost of a basic operation is constant i.e. independent of the size of the operands
 - e.g. $x + y$ will take unit time to execute irrespective of the values of x and y

○ Logarithmic Cost Model:

- Cost of a basic operation is a function of the size of the operands
 - e.g. $x + y$ will take time that is a function of $\log(x)$ and $\log(y)$

TIME COMPLEXITY

- What is the time complexity of this procedure?

- $F(N)$

- ```
{
 prod=1;
 for j = 1 to N { prod = prod * j; }
}
```

- Hint: Which cost model are you using?

- Question: Is this a polynomial-time procedure or an exponential-time procedure?

- Hint: *Time complexity must always be expressed in terms of input size i.e. size of representation of input data*