

Limits To Computation

**CSE
100**

The speed of computers and the breadth of their application is awesome, leaving us with the impression that they can do anything. They cannot. Consider some of the limitations to computation.

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Computers Use Resources

- ❖ Each operation of a computer (each step in the Fetch/Execute Cycle) takes a small amount of time
 - + As a rough approximation, assume 1 instruction per clock tick
 - + A 500MHz computer does 500,000,000 instructions in a second
- ❖ Generally, the number of instructions needed to solve a problem determines how much time it will take ...
 - + A 10 billion instruction computation takes 20 seconds
- ❖ Networks have bandwidth limits: 100 Mb/sec
- ❖ Every part of a computation takes memory, too.

Every letter or digit takes 1-2 bytes
Every instruction takes 4 bytes
Every integer takes 2 or 4 bytes
Every decimal number takes 4 or 8 bytes

... And everything
is limited by the
speed of light

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The Resources Limit Computation

- ❖ Computations are described by how long they run based on the amount of data they are given ...
 - ✦ A problem that runs for a minute on a given amount of data, and runs for two minutes on twice as much data, etc. is said to be a “linear computation”
 - ✦ Computing the weekly pay and deductions for employees is an example because twice as many employees would take twice as long to compute pay and deductions
- ❖ There are much more complicated computations
 - ✦ A quadratic computation takes 4 times the time when there is twice the data
 - ✦ Checking to see if an employee is married to another employee might be an example
 - ✦ “Exponential problems” take twice the time when adding just one more data value

Difficult Problems

- ❖ There are a variety of kinds of problems that computers “cannot” perform
 - ✦ Unsolvable problems cannot be computed ... solving them is logically inconsistent
 - ✦ Some problems cannot be solved because the inputs cannot be known ... predicting today’s close of the Amazon.Com stock price
 - ✦ Some problems could be solved in principle, but it would take so long and take so many resources that it is impractical ... simulating the positions of the stars in the Milky Way galaxy over a million years
 - ✦ Intractable problems could be solved if you could guess effectively, but with known methods, they are impractical

The Knapsack problem is an example of an intractable problem

CSE 100 Project 2

“Yes, But Is It Art?”

- ❖ Project 2 is designed to give you practice writing procedures in VB6.0. The task will be to apply the graphics capabilities of VB6.0 to present an interesting or aesthetic image to the viewer
- ❖ You can do just about anything, if it has procedures...

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CSE 100 Parameters Of Project 2

- ❖ You need to produce a form that is aesthetically please while using ...
 - + A procedure with at least 2 parameters
 - + A procedure that calls another of your procedures
 - + A procedure that is called from at least 5 different places in your program
 - + A function, i.e. a value returning procedure
 - + An iteration statement
 - + A case conditional statement
- ❖ Due dates
 - + Intermediate grade point -- Thursday April 28, 1999
 - + Final turn-in -- Tuesday, May 4, 1999
- ❖ Prizes will be awarded

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