INTRODUCTION

Analysis of Algorithm

Faculty of Computing and Information Technology (FCIT)
University of the Punjab, Lahore, Pakistan.

Credit

- *Algorithms Part 1* by **Kevin Wayne** and **Robert Sedgewick**, Princeton University available at **Coursera**

- *Algorithms: Design and Analysis* by **Tim Roughgarden**, Stanford University available at **Coursera**

About the course

- 3-0-0 credit hours course.

- In this course, we discuss how to develop and analyse computer programs which can run efficiently.

- Lets discuss the syllabus hand-out.

Why study algorithm?

Internet. Web search, packet routing, distributed file sharing, ...

Biology. Human genome project, protein folding, ...

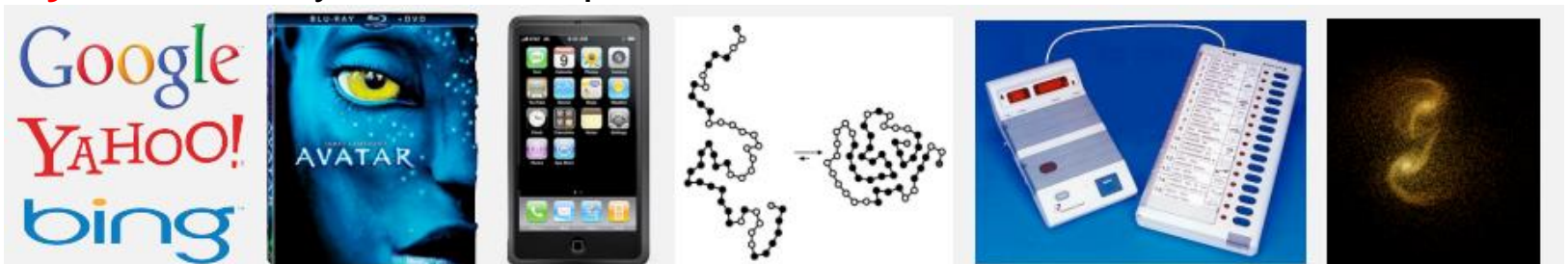**Computers.** Circuit layout, file system, compilers, ...

Computer graphics. Movies, video games, virtual reality, ...

Security. Cell phones, e-commerce, voting machines, ...

**Multimedia**. MP3, JPG, DivX, HDTV, face recognition, ...

Social networks. Recommendations, news feeds, advertisements, ...

Physics. N-body simulation, particle collision simulation, ...

Examples to use algorithms

- An instructor needs to count number of students in a class quickly.

- A student needs to search allocated space for an entry test scheduled in a big hall where expected number of students are more than 10,000.

- A tourists wants to visit the entire attractive places in a city with minimum travel time and money.

- A mobile company wants to introduce a new calling package to maximize the number of users to switch to the new package.
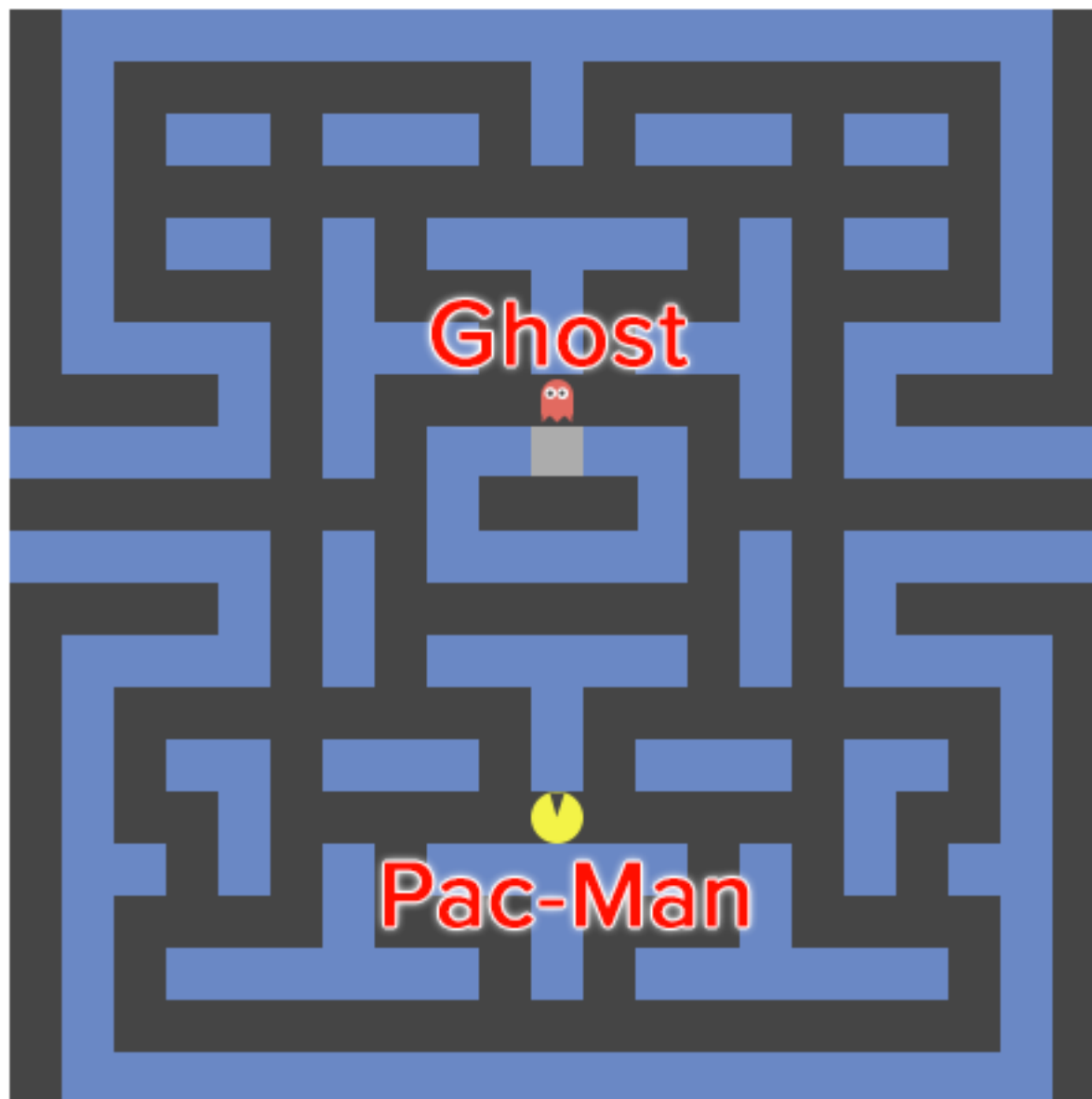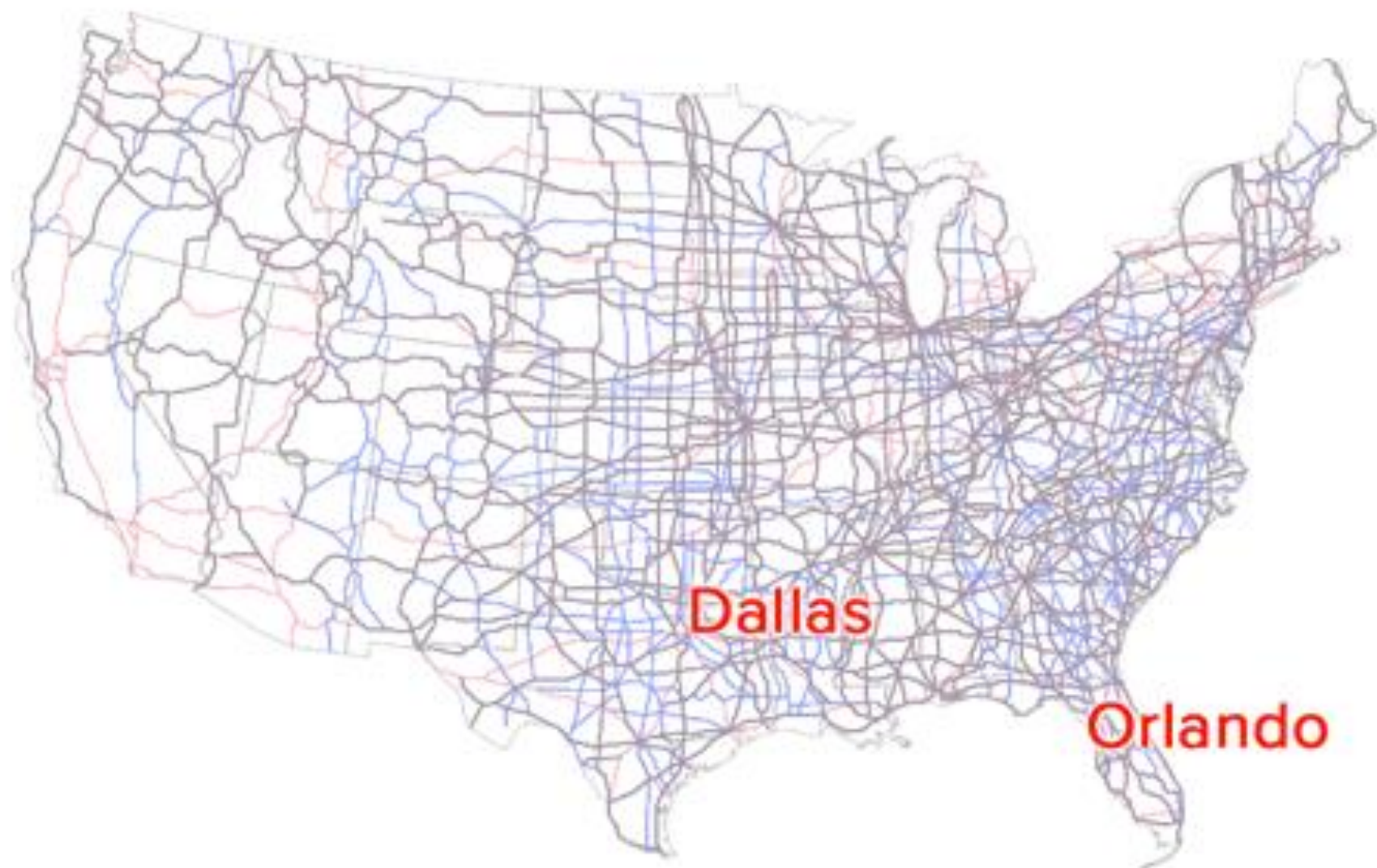
Exhaustive Search

Theoretically, many puzzles can be solved by exhaustive search—a problem-solving strategy that simply tries all possible candidate solutions until a solution to the problem is found.

Magic Square Fill the 3×3 table with nine distinct integers from 1 to 9 so that the sum of the numbers in each row, column, and corner-to-corner diagonal is the same (Figure 1.1).

?	?	?
?	?	?
?	?	?

" *I will, in fact, claim that the difference between a bad programmer and a good one is whether he considers his code or his data structures more important. Bad programmers worry about the code. Good programmers worry about data structures and their relationships.* "

— *Linus Torvalds (creator of Linux)*

" *Algorithms + Data Structures = Programs.* " — *Niklaus Wirth*

Computational models are obsoleting

Computational models are replacing math models in scientific inquiry.

$$E = mc^2$$

$$F = ma$$

$$F = \frac{Gm_1 m_2}{r^2}$$

$$\left[-\frac{\hbar^2}{2m} \nabla^2 + V(r) \right] \Psi(r) = E\, \Psi(r)$$

20th century science
(formula based)

```
for (double t = 0.0; true; t = t + dt)
    for (int i = 0; i < N; i++)
    {
        bodies[i].resetForce();
        for (int j = 0; j < N; j++)
            if (i != j)
                bodies[i].addForce(bodies[j]);
    }
```

21st century science
(algorithm based)

Algorithm

- Algorithm is a sequence of steps to solve a problem.

- Sequence of computational steps

- Takes one or more inputs

- Produce one or more outputs

Analysis of Algorithm

- Theoretical study of computer programs for performance and resources.

- Performance: Execution Time

- Resources: Space / Memory