CSIT113
Problem Solving

Workshop
Week 2

SOLUTIONS

Where's Wally

He's here! 

He is usually harder to find…

Can you think of a good strategy to find him?

Discuss this in your groups.

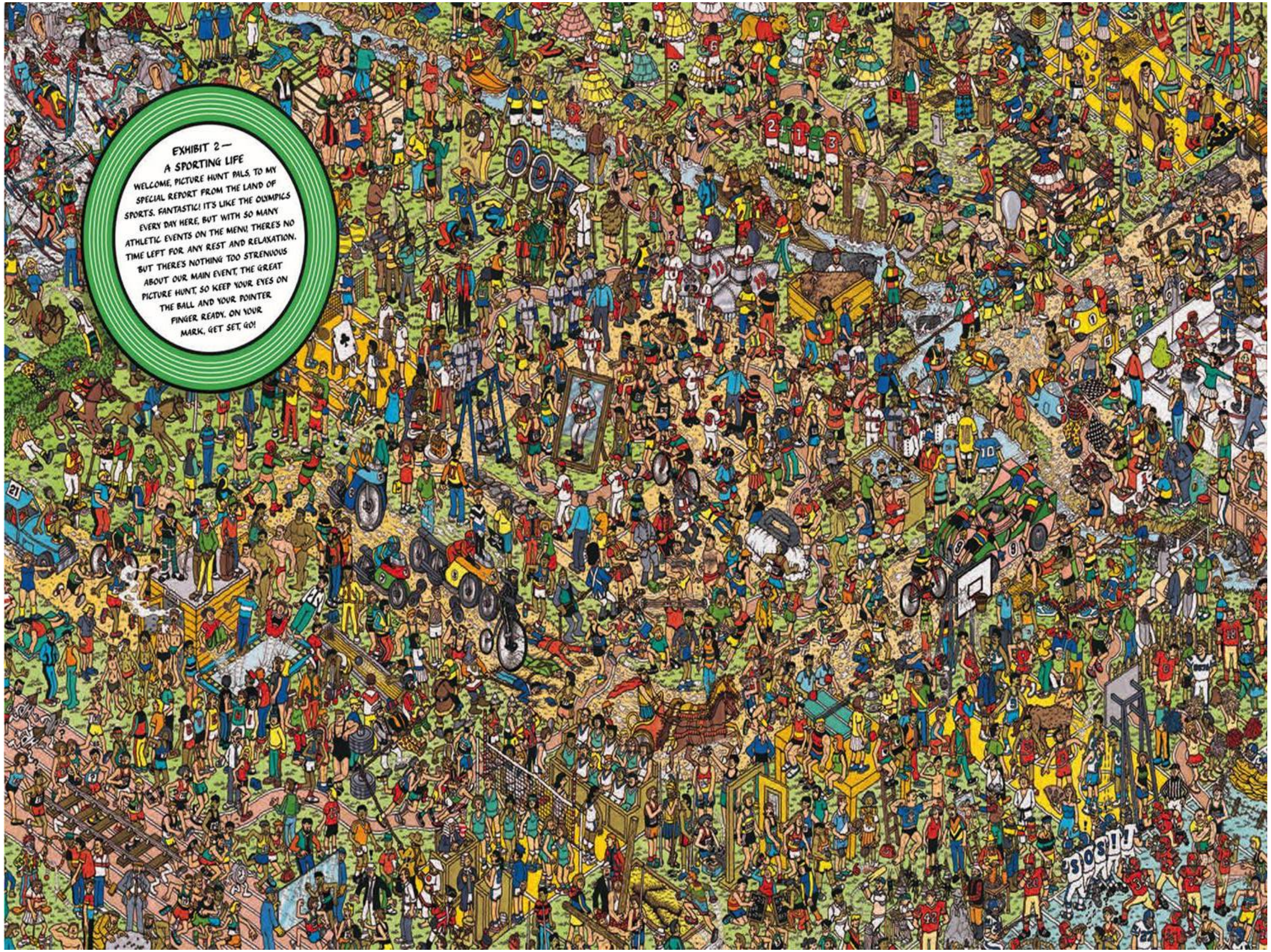
EXHIBIT 2—
A SPORTING LIFE
WELCOME, PICTURE HUNT PALS, TO MY SPECIAL REPORT FROM THE LAND OF SPORTS. FANTASTIC! IT'S LIKE THE OLYMPICS EVERY DAY HERE, BUT WITH SO MANY ATHLETIC EVENTS ON THE MENU, THERE'S NO TIME LEFT FOR ANY REST AND RELAXATION. BUT THERE'S NOTHING TOO STRENUOUS ABOUT OUR MAIN EVENT, THE GREAT PICTURE HUNT, SO KEEP YOUR EYES ON THE BALL AND YOUR POINTER FINGER READY. ON YOUR MARK, GET SET, GO!

Solution for the Wally problem:

- I put an illustration on the floor showing a large crowd of people.
- After asking you to cover your eyes, I cover the illustration with a large, flat piece of black cardboard (which covers far more area than the illustration itself) with a tiny cutout in it. The tiny cutout allows us to see Wally, but where he is located in the image or where the puzzle begins and ends.
- Then, I ask you to close your eyes again, and I take the board off the Where's Wally puzzle.

A Game

I like cats but I don’t like dogs.

I like elephants and alligators but not crocodiles.

Whales are fine but fish I cannot stand.

I like apples and grapes but not lemons.

Does anyone know what I am talking about?

Solution to A Game

Concentrate on what I like to find the common point of them, while comparing with what I dislike.

LIKE	DISLIKE
cats	*dogs*
elephants, alligators	*crocodiles*
whales	*fish*
apples, grapes	*lemons*

To conclude, I am talking that I love words containing “a”.

Another one

I like frogs but not tadpoles.

I like kittens and cats.

I don't like penguins and I don't like bats.

I like most tables but I don't like trees.

I cannot stand snakes, so tell me please.

What do I like?

Solution to Another one:

Concentrate on what I like to find the common point of them, while comparing with what I dislike.

LIKE	DISLIKE
frogs	*tadpoles*
kittens and cats	*Penguins, bats*
most tables	*trees*
	snakes
All have 4 legs	

To conclude, I like things with 4 legs.

Last one.

I like aces not kings
Not buttons or rings.
I’d like a cent but not a dollar
Not a hat and not a collar.
An exits no good, but a door is okay
No doorway can ever quite please me I say.
I’d happily dent but never would bend
This stupid poem is now at an end!

What do I like?

Solution to Last one:

Please remark that all words that I like are comprised of letters in alphabetical order.

LIKE	DISLIKE
Aces (a →c →e →s)	*Kings, buttons, rings,*
Cent (c →e →n →t)	*Dollar, hat, collar*
Door (d →o →o →r)	*exits*
	doorway
Dent (d →e →n →t)	*bend*

To conclude, I like letters in alphabetical order.

- There are four problems which you are to work through in groups of about 4 to 6.

- For each problem:
    1. Clearly identify the problem.
    2. Identify the start state.
    3. Identify any constraints.
    4. Identify the operators.
    5. Look for ways to simplify the problem
    6. Look for ways to abstract the problem.
    7. Think about an appropriate notation for the problem.

- Discuss what you are doing as you go.
    - It’s more about the process than the solution.

Problem 1

- You have a bag with three types of object in it.
- Each turn you remove 2 objects of different types and replace them with an object of the third type.
  - You are allowed to look in the bag when you are taking things out ☺
- **For what starting conditions can we finish with exactly one object in the bag?**

Solution to Problem 1:

Let A, B, C be three types of object contained in the bag. Assume that, there are x A's, y B's and z C's.
Let's start from the result that we would like to achieve.
Without loss of generality, we can assume that in the final state there is 1 A left (odd), while B and C are 0 (even).

In every move, we takes 2 objects of different types (such as -1 A and -1 B) out and then put 1 of the remaining type in (e.g., +1 C). Then, it is easy to see that the parity of x, y, z are changed after move.

State	A	B	C
Initial	*x*	*y*	*z*
	x-1	y-1	z+1
second final	*even*	*odd*	*odd*
Final	*1 (odd)*	*0 (even)*	*0 (even)*

The starting conditions should be **two of {x,y,z} must be the same parity.** We cannot start with (even, even, even) or (odd, odd, odd)

Problem 2

- A group of adults and children want to cross a river.
- The boat will hold one adult or up to two children.
- **How can they all cross?**
- **What must be true for the problem to be soluble at all?**

Solution to Problem 2:

Let C, A stand for “children” and “adult”, respectively.

- The way to cross the river is to repeat the process CC➔, 🡐C, A➔, 🡐C,…, CC➔, 🡐C, A➔, 🡐C until all A cross the river. Then repeat CC➔ , 🡐C, CC➔ until all C are on the right bank of the river.
- At least two children and all adults have to be able to row the boat.

Problem 3

- Alice, Bob, Carol and Dave want to cross a river.
- They have a boat with a capacity of 100Kg.
- Alice weighs 46Kg, Bob 49Kg, Carol 52Kg and Dave 100Kg.
- Bob Can’t Row!
- **Find a way to get them all across.**

Solution to Problem 3:

It is an easy problem. The important is to always keep max 100 kg on the boat at one time.
One solution is as follows:
Alice and Bob go first, Then Alice comes back alone.
Then Alice and Carol cross. And Alice comes back.
Dave crosses alone and Carol goes back.
Finally Alice and Carol cross together.

Problem 4

- You have to cook *n* pancakes, where $n > 0$, using a frying pan that can only hold up to two pancakes at a time.
- Each pancake has to be cooked on both sides; each side requires one minute to cook, regardless of how many pancakes are in the pan.
- What is the minimum time required to cook *n* pancakes (for any value of *n*)?
- How do you achieve this minimum time?

Solution to Problem 4:

Let consider some simple cases first.

- n=1: each side takes 1 minute ➔ 1 pancake takes 2 minutes
- n=2: We cook in pairs➔2 pancakes take 2 minutes
- n=3: Let P1, P2, P3 be three pancakes. If we cook P1, P2 until done, and then cook P3, it takes up to 4 minutes. Actually, we can cook P1, P2, P3 with just 3 minutes. To do that, we perform as follows: first, 1 side of P1+1side of P2; second, 1 side of P2 + 1side of P3; and lastly 1 side of P1 + 1 side of P3.

Generally,

- n even: (i.e., n=2k, for some $k \geq 1$) we cook in pairs➔ It takes n minutes
- $n \geq 3$ and odd: We can write n=2m+3, for some $m \geq 0$, we cook in pairs for 2m (takes 2m minutes), then for the 3 pancakes left we cook as above (takes 3 minutes). In total, it takes 2m+3=n minutes

To conclude, the minimum time required is n minutes for n>1, and n+1 minutes for n=1.