Lesson 20: Intro to Algorithms (W06D2)

Balboa High School

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Do Now

1. On a sheet of paper, divide 16289 by 7 using *long division*.
2. You may be called upon to guide your teacher — who is a math teacher! — through the same task. To prepare, think of the *reasons* why you did everything you did when evaluating $16289 \div 7$.

Sign-off opportunities for PS #3's paper form:

- later this period
- Homeroom tomorrow
- immediately after 6th Period tomorrow

Aim

Students will be introduced to algorithms, pseudocode, flowcharts, and basic iteration using `while()`.

Do Now: Teach Me Long Division!

To the board. . .

Algorithm

- A step-by-step process for doing something
- We write programs that *implement* algorithms, putting them to use

Algorithms You've Used

Examples of algorithms you've benefited from

- Getting directions via Google Maps — *shortest path* algorithms from *Graph Theory*

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Examples of algorithms you've benefited from

- Getting directions via Google Maps — *shortest path* algorithms from *Graph Theory*
- Visiting any website — algorithms running on IP routers decided how and when to move your data packets over the Internet requesting content from remote servers
- Typing on a smartphone — an algorithm predicts what word(s) you might be typing based on the letters typed thus far

Describing Algorithms

Two ways of describing algorithms:

- **Pseudocode:** not quite a high-level language (simpler syntax and style!); useful for describing a set of instructions that can then be implemented in your language of choice (e.g., Java!)
- **Flowcharts:** a visual means of showing an algorithm's flow

An Algorithm You'd Better Not Know

- How does a procrastinator work?
- What is his (or her) M.O.[1]?

[1] M.O. is short for *Modus Operandi*, which is Latin for *mode of operation*

An Algorithm You'd Better Not Know

Pseudocode:

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$\mathbf{t_{min}} \leftarrow$ `est. minimum time to complete PS#4`

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`while (` $\mathbf{t_{remaining}}$ `>` $\mathbf{t_{min}}$ `):`

An Algorithm You'd Better Not Know

Pseudocode:

```
t_min ← est.  minimum time to complete PS#4
t_remaining ← (time due) - (current time)

while ( t_remaining > t_min ):
    d ← choose distraction
```

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t_min ← est.  minimum time to complete PS#4
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An Algorithm You'd Better Not Know

Pseudocode:

$\mathbf{t_{min}}$ ← est. minimum time to complete PS#4
$\mathbf{t_{remaining}}$ ← (time due) - (current time)

while ($\mathbf{t_{remaining}}$ > $\mathbf{t_{min}}$):
    d ← choose distraction
    engage in **d** for 1h...
    recalculate $\mathbf{t_{remaining}}$

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Pseudocode:

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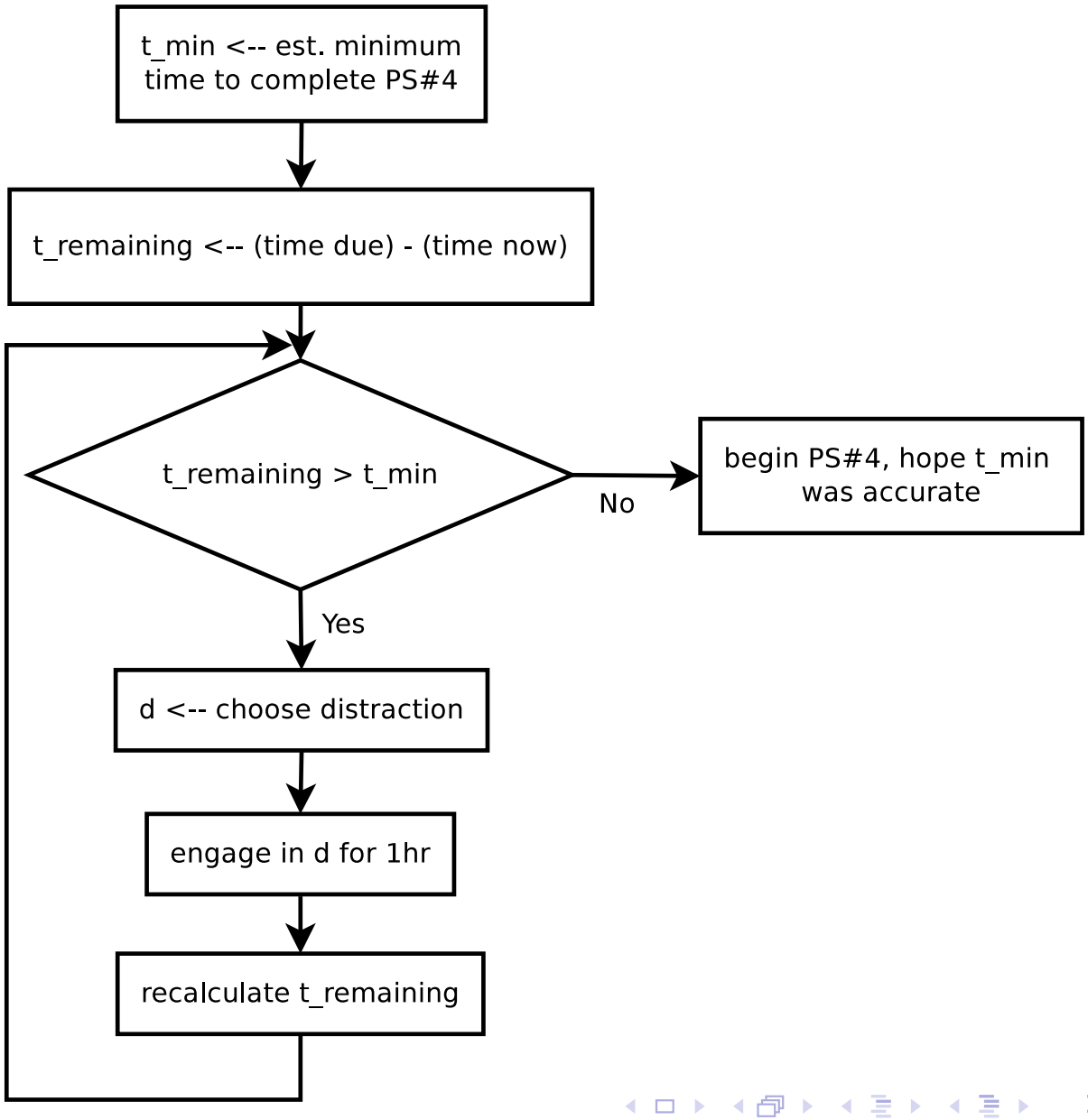
t_remaining ← (time due) - (current time)

while ( t_remaining > t_min ):
    d ← choose distraction
    engage in d for 1h...
    recalculate t_remaining

begin problem set, hope t_min was accurate
```

An Algorithm You'd Better Not Know



while()

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- finally, non-sequential programs

while()

- your first flow control statement!
- finally, non-sequential programs
- syntax:

```
while ( <condition is true?> ) {
    run the code in this block...
}
```

while() Example

What does this code snippet do?

```
int a = 0;

while ( a < 10 ) {
    System.out.println(a);
}
```

`while()` Example

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int a = 0;

while ( a < 10 ) {
    System.out.println(a);
}
```

→ See what the code does:

- Create a new project called `Lesson20` in `workspace0`
- Create class `WhileOne` in the new project
- Insert the `while()` loop into that class' `main()` and run it

while() Example

```
int a = 0;

while ( a < 10 ) {
    System.out.println(a);
}
```

- The **stopping condition** is what causes the `while()` loop to terminate (finish).

`while()` Example

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int a = 0;

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- In this case, it's when it is no longer true that a < 10. In other words, if a ≥ 10, the program may end.

`while()` Example

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}
```

- The **stopping condition** is what causes the `while()` loop to terminate (finish).
- In this case, it's when it is no longer true that a < 10. In other words, if a ≥ 10, the program may end.
- We need a **loop variant** here — something that changes each time the loop iterates — so that we get closer to the stopping condition over time.

while() Example: Fixed!

```
int a = 0;

while ( a < 10 ) {
    System.out.println(a);
    a = a + 1;          // loop variant:
                        // 'a' changes over time
}
```

Playing with `while()`

- Replace the

  ```
  a = a + 1;
  ```

  line with

  ```
  a++;
  ```

  [2]

- change the `while()` condition from

  ```
  a < 10
  ```

  to

  ```
  a <= 10
  ```

[2] "++" is an **incrementer** operator, increasing the value of the var by 1

Programming Exercises

1. Write a program to display all positive integers up to 100.
2. Write a program to display all even positive integers up to 84.

HW

Work on PS #4a, §§1-3.4, inclusive.[3]

[3] That means §1 through §3.4, *including* §1 and §3.4!