Design and Implementation of Online Experiments

nodeGame.org

Stefano Balietti

MZES and Heidelberg

nodeGame: Getting Started

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Who Develops NodeGame?

Me! (shakty)

B. Vartok, L. Miserez, J. Dorrie,
P. Kueng, Ewen Wang, and others.
(thanks!)

Why Is It Called NodeGame?

It comes from Node.JS, in which it is implemented, particularly suited for real-time interactive games.

Why Node.JS ?

Built on Chrome's V8 JavaScript engine, it uses an event-driven, non-blocking I/O model that makes it lightweight and efficient.

Node.js' package ecosystem, npm, is the largest ecosystem of open source libraries in the world.

Install Required Packages

1. **Git** Latest https://git-scm.com (Windows users install and use Git Bash)
2. **Node.JS** LTS https://nodejs.org/en

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1. **Git** Latest https://git-scm.com (Windows users install and use Git Bash)
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Note! If prompted, do *not* install extra "necessary" software.

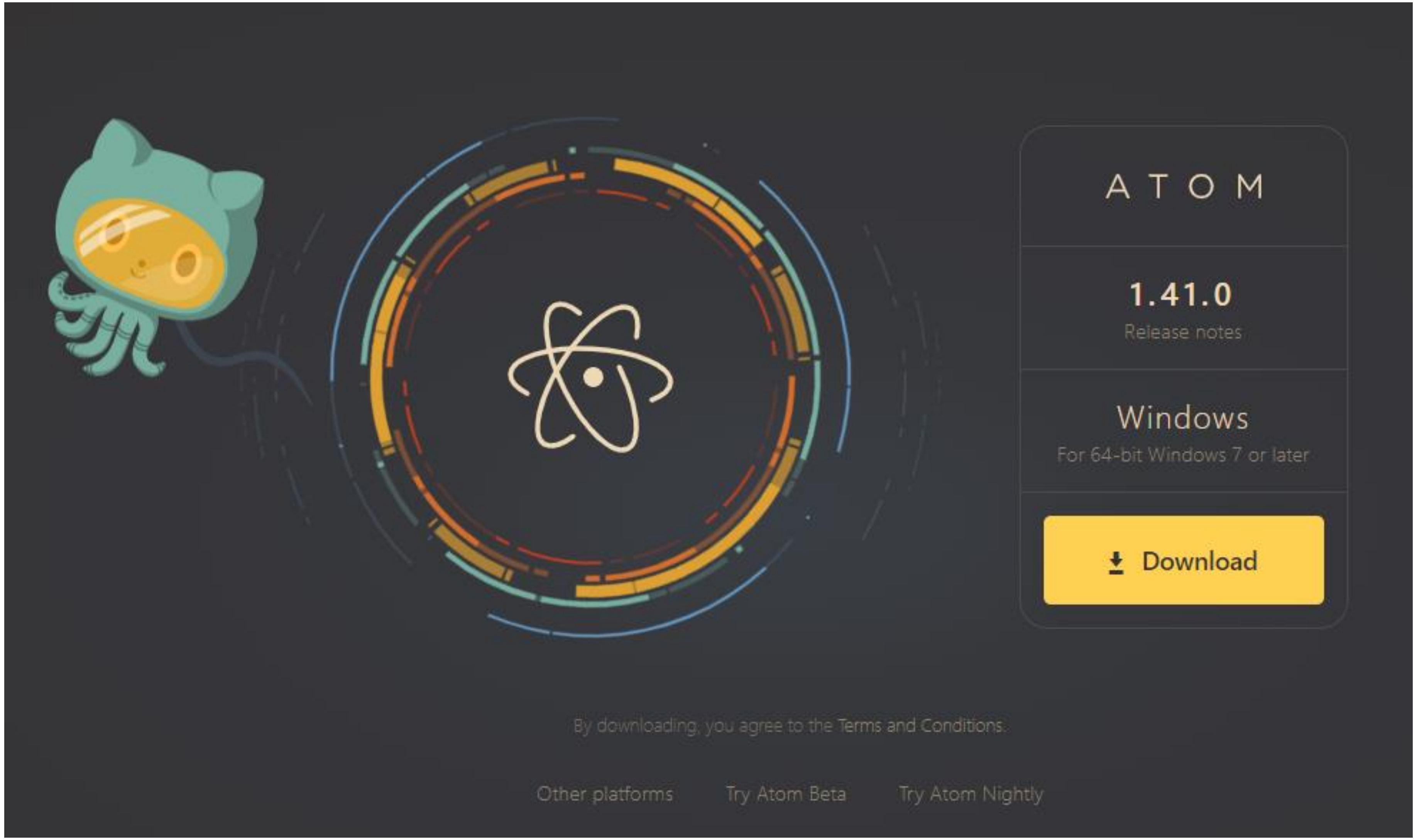
Install Required Packages

1. **Git** Latest https://git-scm.com (Windows users install and use Git Bash)
2. **Node.JS** LTS https://nodejs.org/en

3. **Text Editor** with syntax highlighting associated with .js files
   - Simple: Notepad++ (Windows), TextMate, TextWrangler (Mac), Geany (both)
   - Advanced: **Atom**, Sublime, Emacs, Vim

nodeGame recommends: ATOM

Atom.io



ATOM

1.41.0

Release notes

Windows

For 64-bit Windows 7 or later

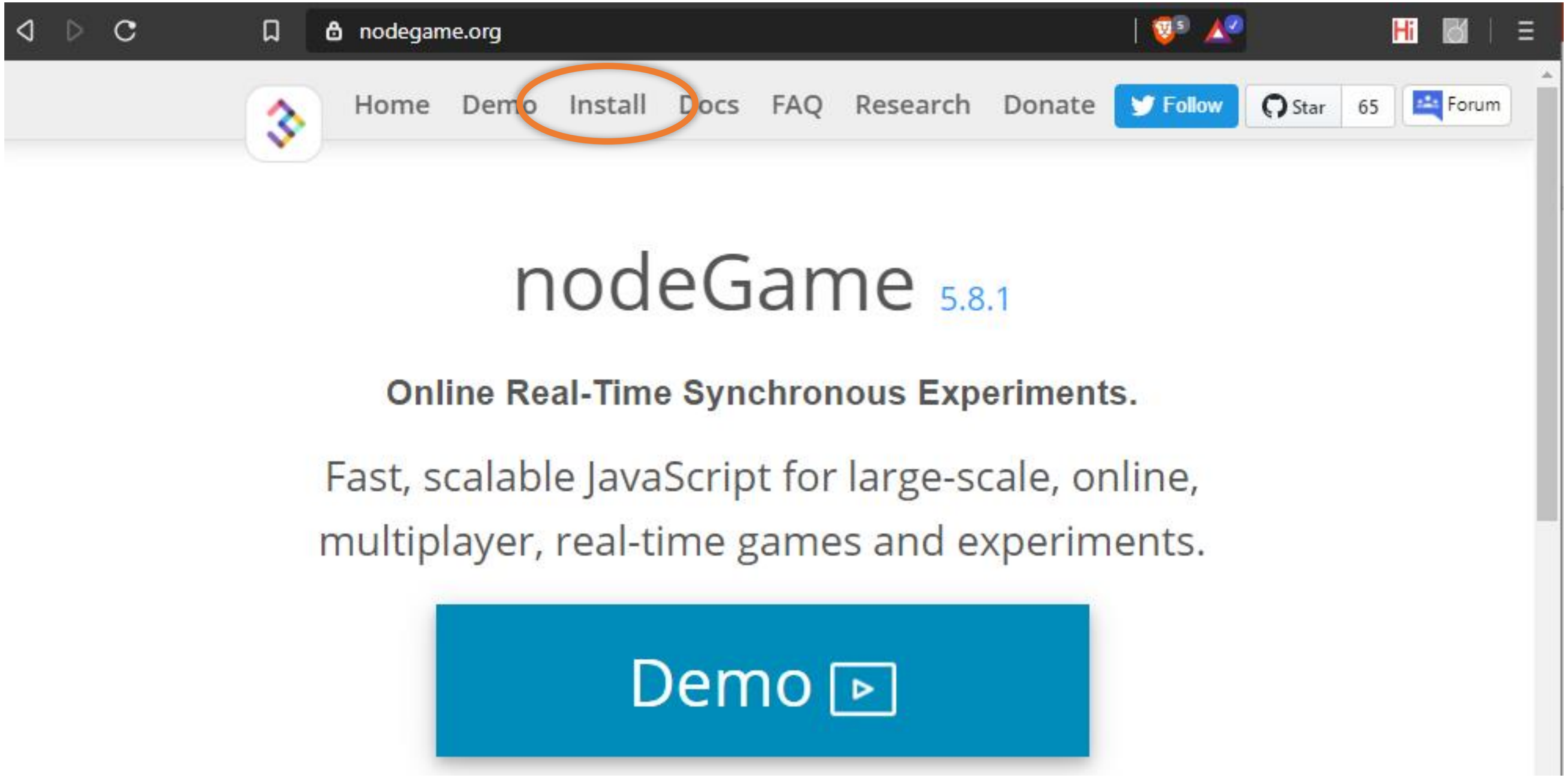
Download

By downloading, you agree to the Terms and Conditions.

Other platforms Try Atom Beta Try Atom Nightly

Install nodeGame

https://nodegame.org

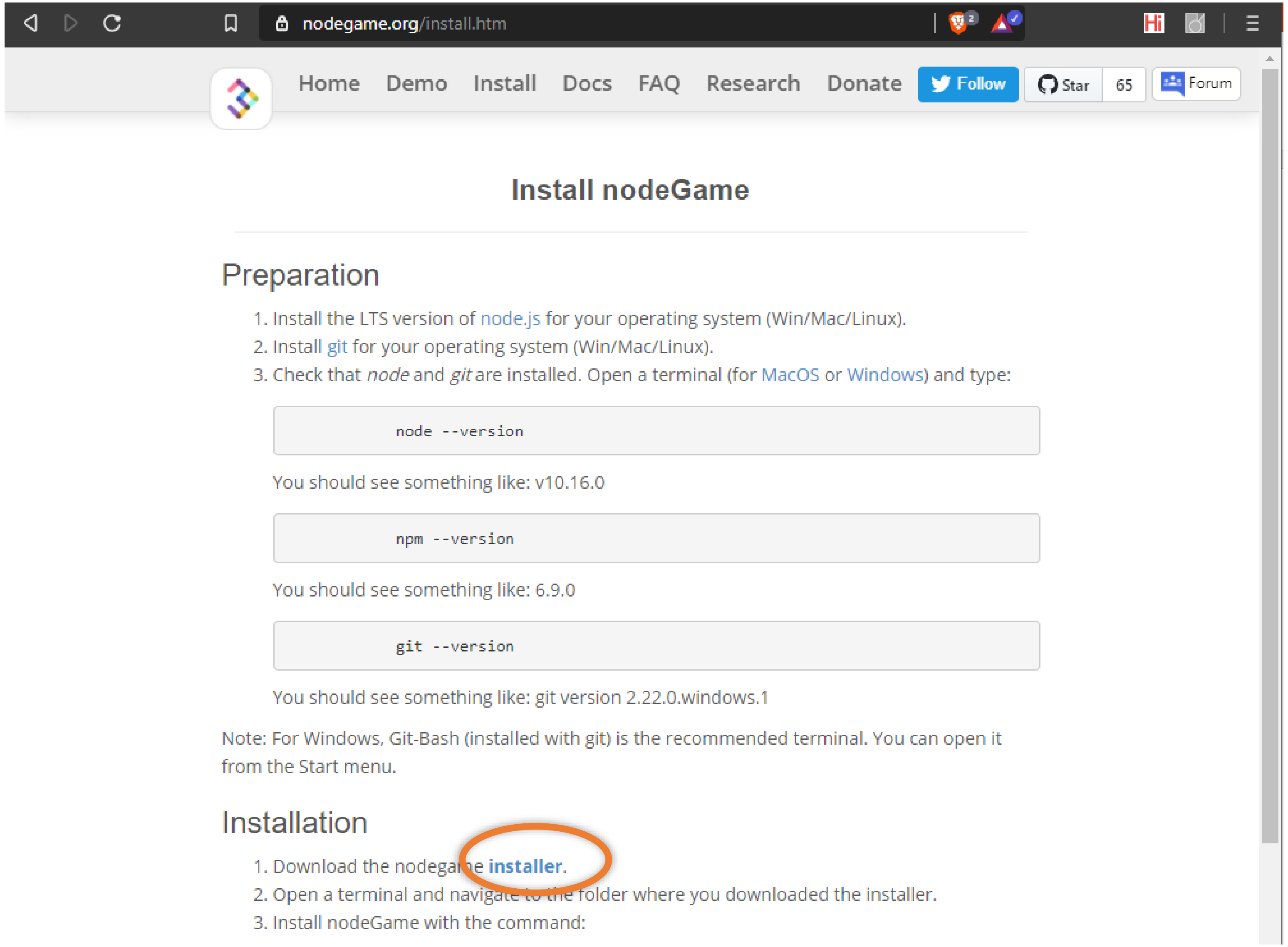


nodeGame 5.8.1

Online Real-Time Synchronous Experiments.

Fast, scalable JavaScript for large-scale, online, multiplayer, real-time games and experiments.

Install nodeGame



Install nodeGame

Preparation

1. Install the LTS version of node.js for your operating system (Win/Mac/Linux).
2. Install git for your operating system (Win/Mac/Linux).
3. Check that *node* and *git* are installed. Open a terminal (for MacOS or Windows) and type:

```
node --version
```

You should see something like: v10.16.0

```
npm --version
```

You should see something like: 6.9.0

```
git --version
```

You should see something like: git version 2.22.0.windows.1

Note: For Windows, Git-Bash (installed with git) is the recommended terminal. You can open it from the Start menu.

Installation

1. Download the nodegame **installer**.
2. Open a terminal and navigate to the folder where you downloaded the installer.
3. Install nodeGame with the command:

- Save the installer inside the folder where you want to install nodeGame
- Now it is time to learn how to use a **Terminal**.

The Terminal

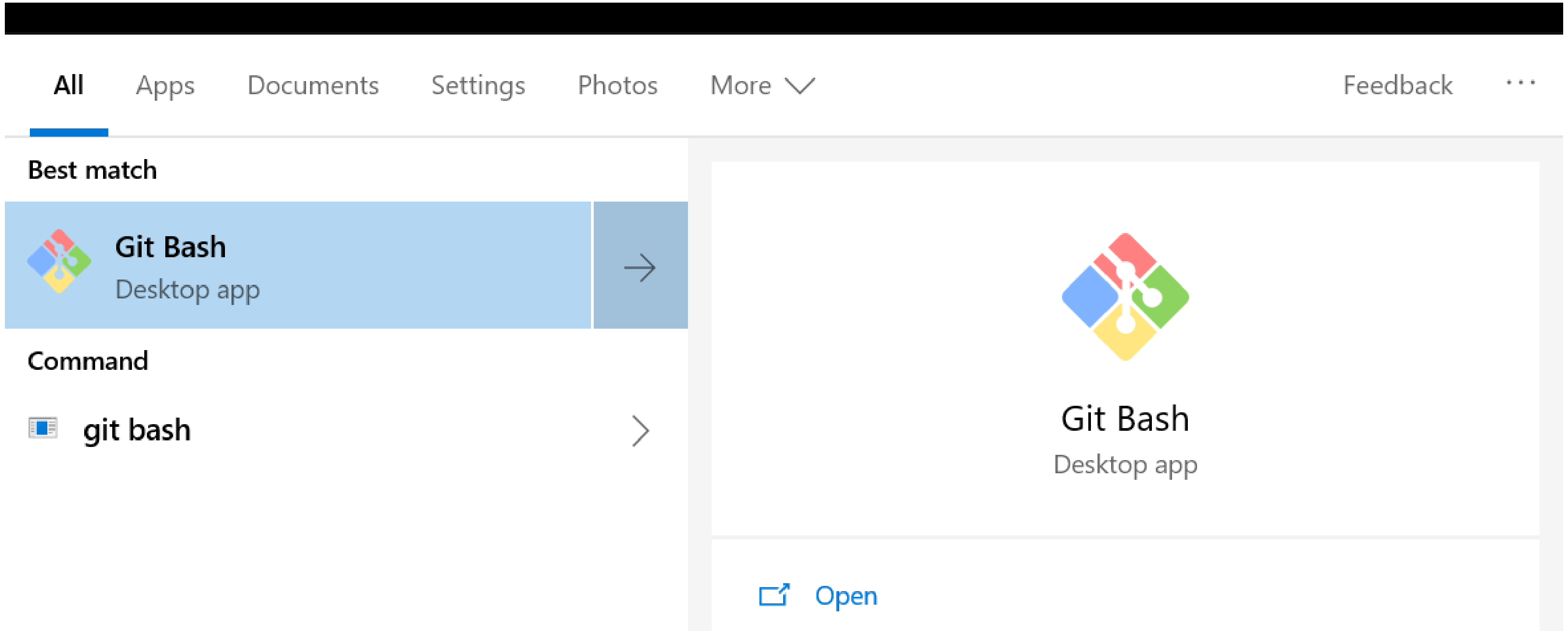
My Friend

The Terminal

The terminal is a window in which you can type in commands that are interpreted and executed by your machine.

- Windows: Git Bash

- Mac / Linux: Terminal



The Terminal

Navigate your way in Git Bash

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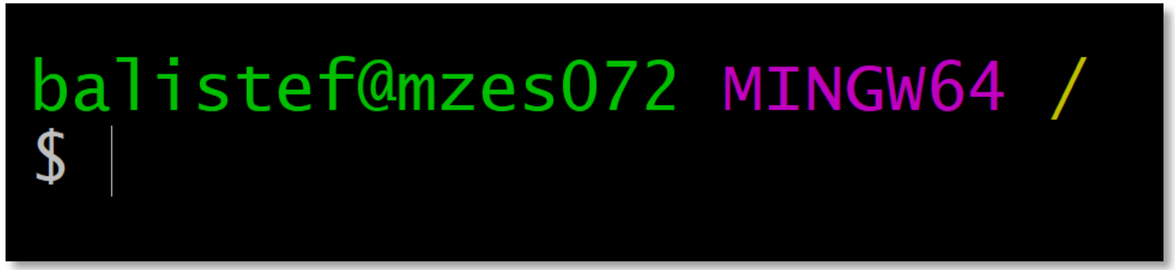
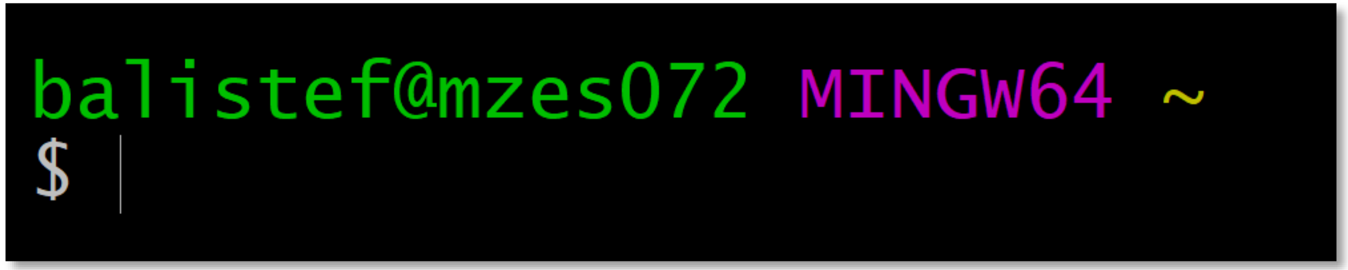


```
balistef@mzes072 MINGW64 /
$ 
```



```
balistef@mzes072 MINGW64 ~
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```

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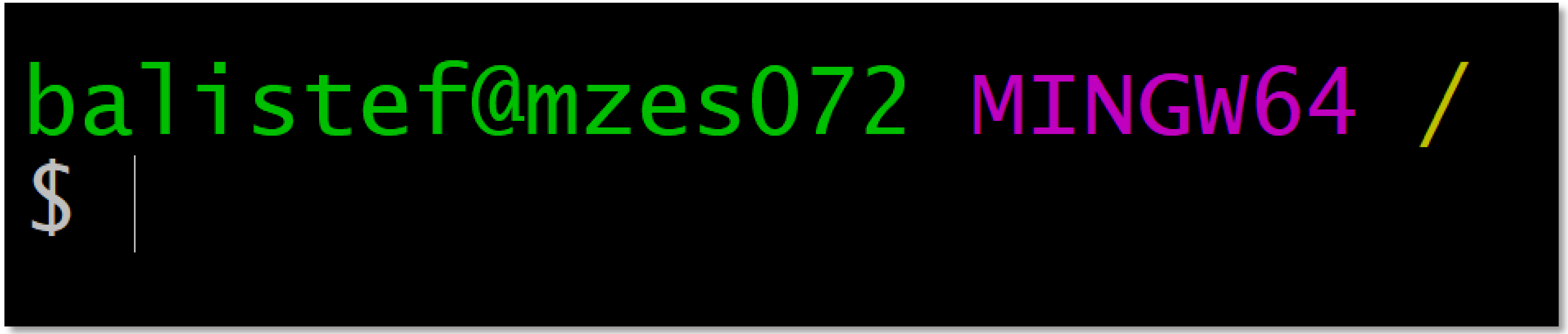

```
balistef@mzes072 MINGW64 /
$ 
```

The Terminal

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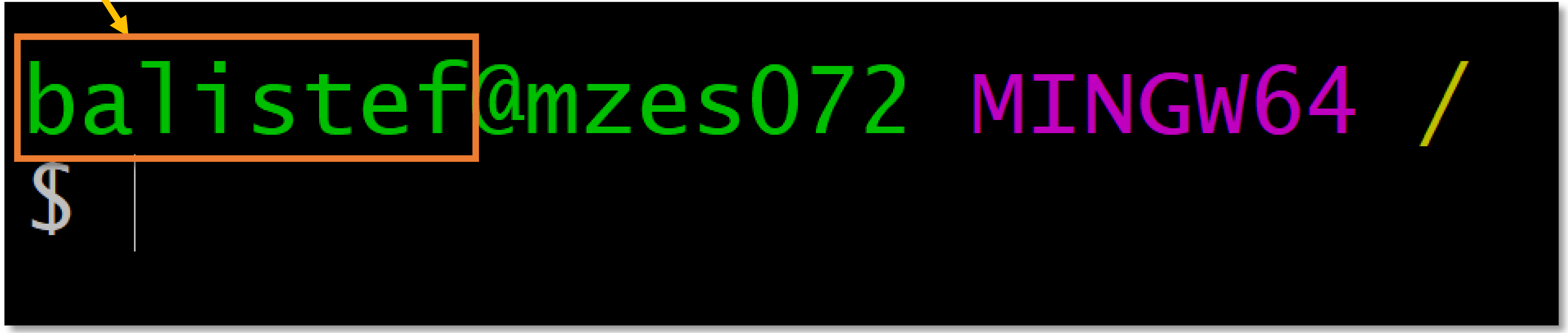
Your username



```
balistef@mzes072 MINGW64 /
$
```

The Terminal

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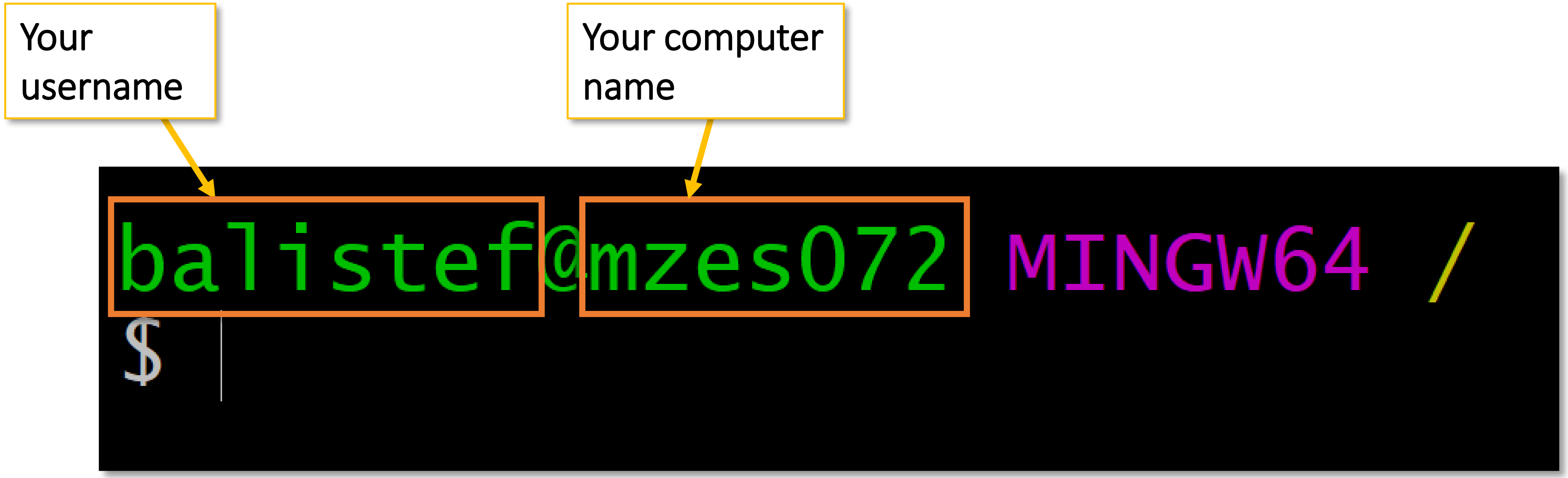

Your username

Your computer name

```
balistef@mzes072 MINGW64 /
$ 
```

The Terminal

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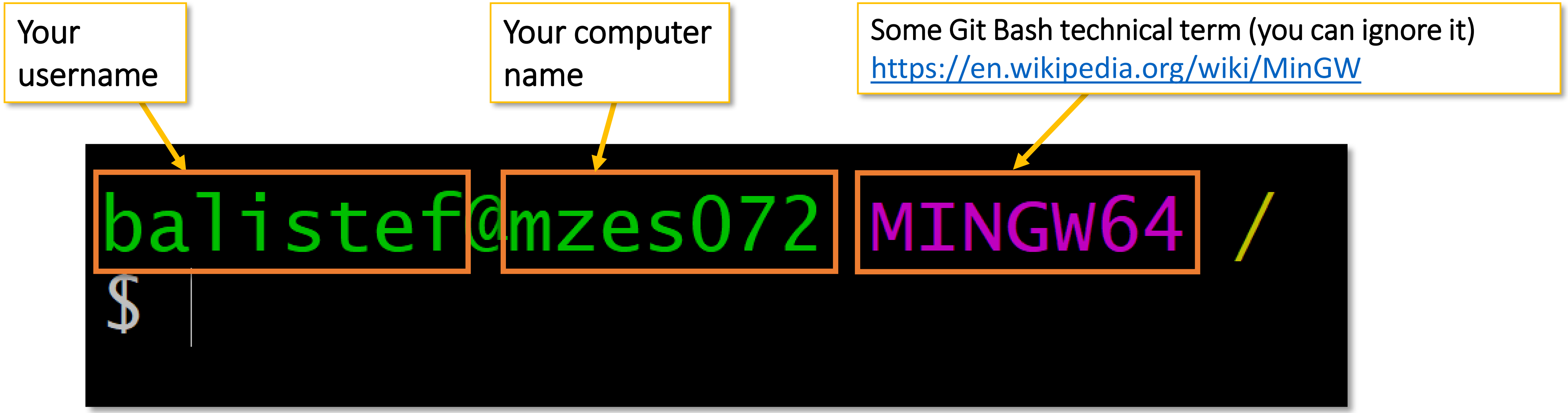

Your username

Your computer name

Some Git Bash technical term (you can ignore it) https://en.wikipedia.org/wiki/MinGW

```
balistef@mzes072 MINGW64 /
$ 
```

The Terminal

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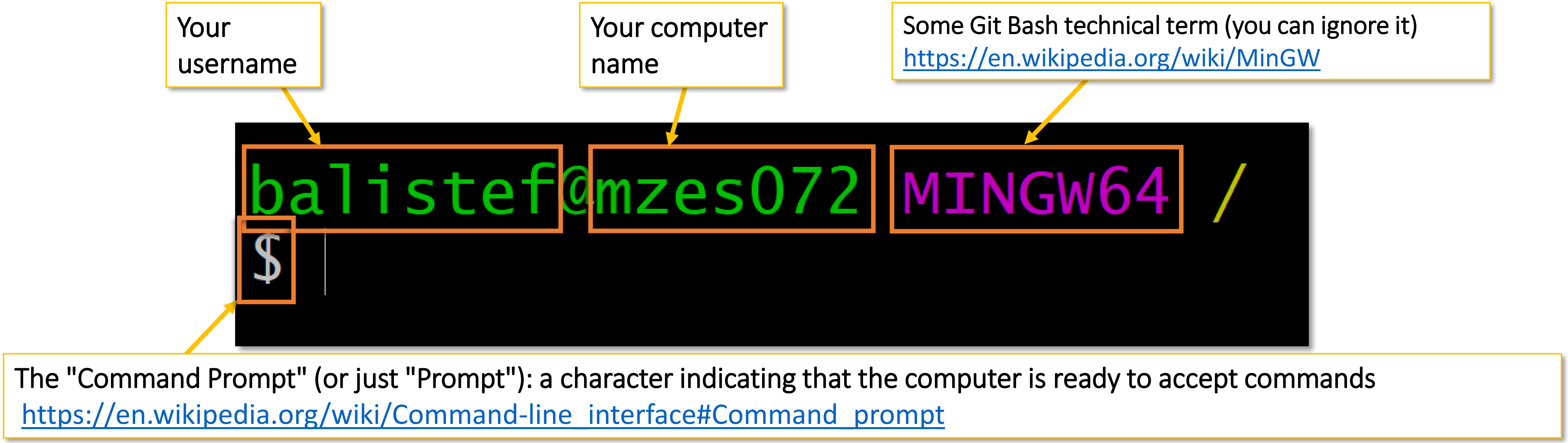

```
balistef@mzes072 MINGW64 /
$
```

Your username

Your computer name

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The "Command Prompt" (or just "Prompt"): a character indicating that the computer is ready to accept commands
https://en.wikipedia.org/wiki/Command-line_interface#Command_prompt

The Terminal

Navigate your way in Git Bash

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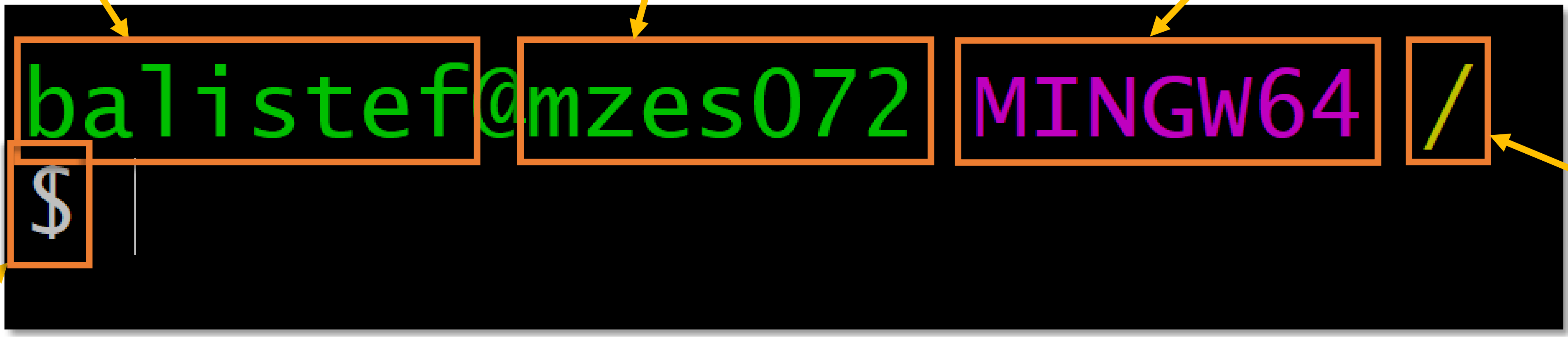

```
balistef@mzes072 MINGW64 /
$
```

Your location on your computer

The "Command Prompt" (or just "Prompt"): a character indicating that the computer is ready to accept commands https://en.wikipedia.org/wiki/Command-line_interface#Command_prompt

The Terminal

Navigate your way in Git Bash

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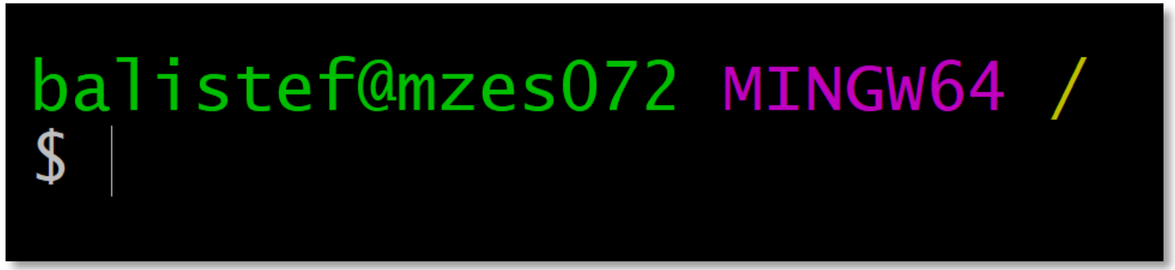
Top Directory

In Windows `C:/`

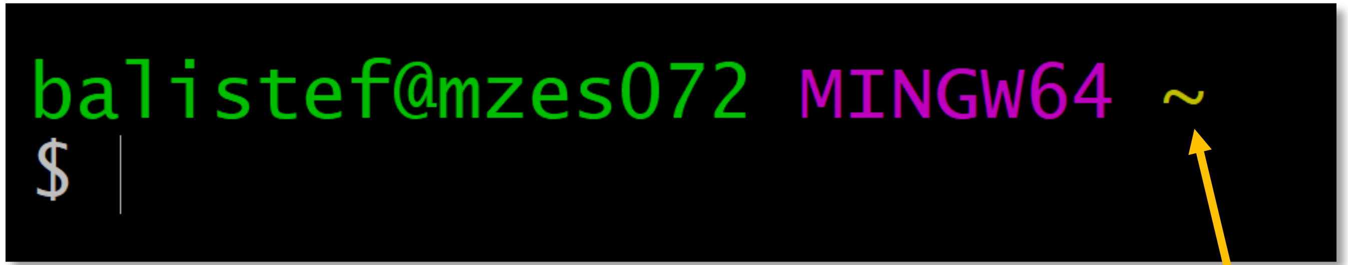


```
balistef@mzes072 MINGW64 /
$
```

This sign is called **slash**. It is used to separate nested directory names. Since there is no name after it, it means it is the root (top) directory of your computer.

Home Directory

In Windows: `C:/Users/yourusername`



```
balistef@mzes072 MINGW64 ~
$
```

This sign is called **tilde**. It means your home directory.

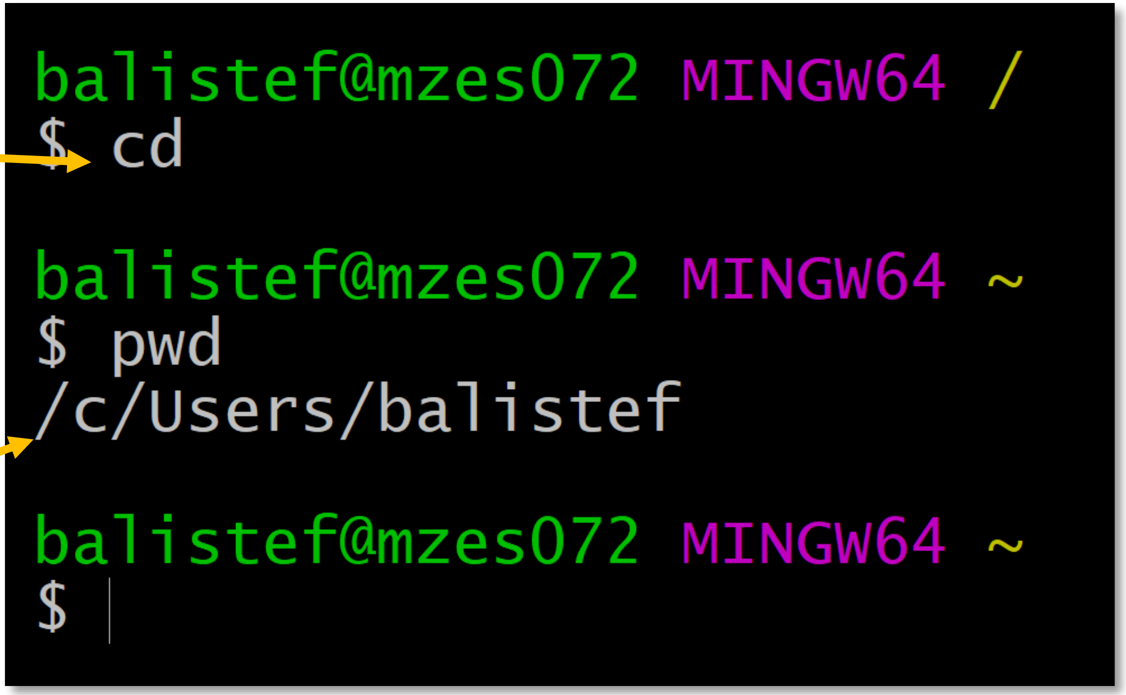
The Terminal

Navigate your way in Git Bash

1. Open Git Bash
2. As you as you open it, you might either be in your **home folder** or in **top directory**. *How to know where you are?*
3. If you are in top directory (or any other), *how do you get back to your home directory*?

The command `cd` (without arguments) brings you back home

The command `pwd` **p**rints the **w**orking **d**irectory

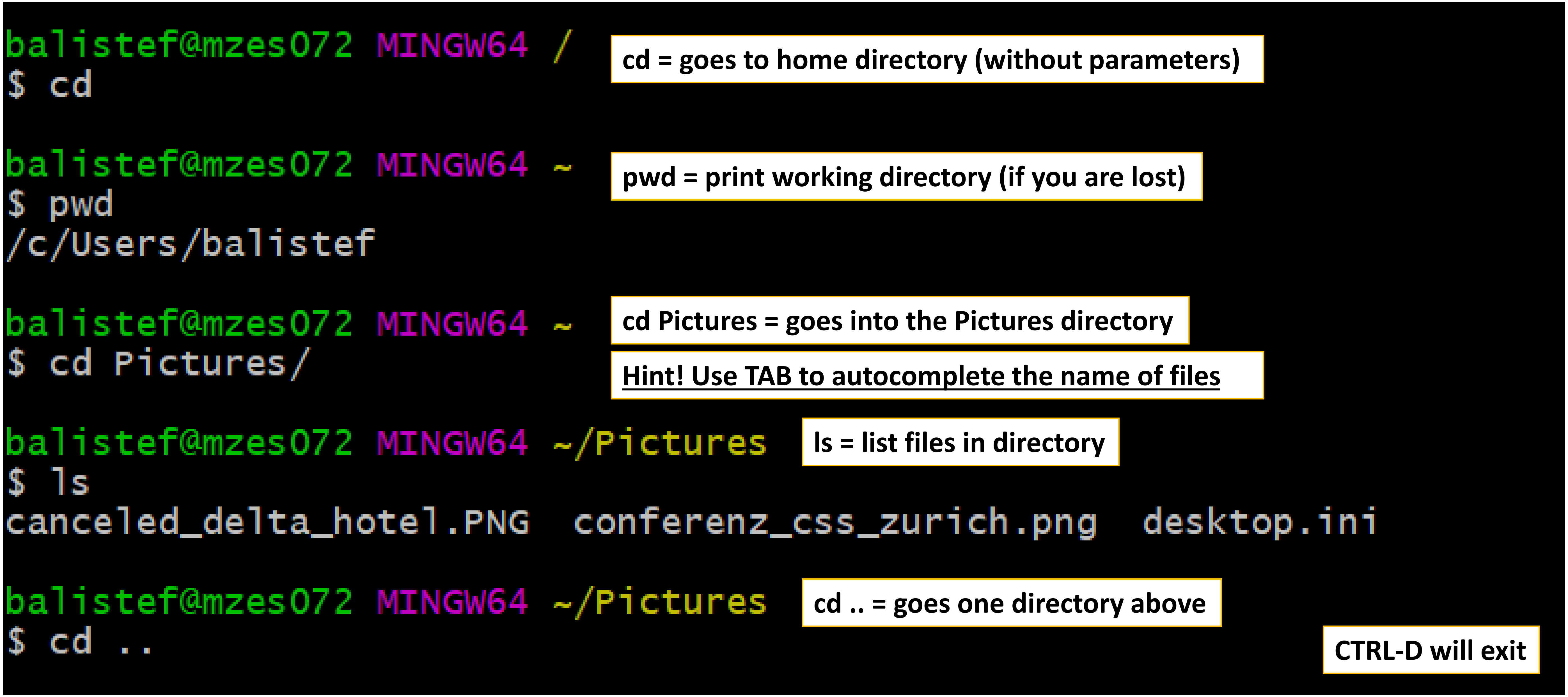


```
balistef@mzes072 MINGW64 /
$ cd

balistef@mzes072 MINGW64 ~
$ pwd
/c/Users/balistef

balistef@mzes072 MINGW64 ~
$ 
```

Terminal Commands To Remember



```
balistef@mzes072 MINGW64 /
$ cd

balistef@mzes072 MINGW64 ~
$ pwd
/c/Users/balistef

balistef@mzes072 MINGW64 ~
$ cd Pictures/

balistef@mzes072 MINGW64 ~/Pictures
$ ls
canceled_delta_hotel.PNG  conferenz_css_zurich.png  desktop.ini

balistef@mzes072 MINGW64 ~/Pictures
$ cd ..
```

cd = goes to home directory (without parameters)

pwd = print working directory (if you are lost)

cd Pictures = goes into the Pictures directory

Hint! Use TAB to autocomplete the name of files

ls = list files in directory

cd .. = goes one directory above

CTRL-D will exit

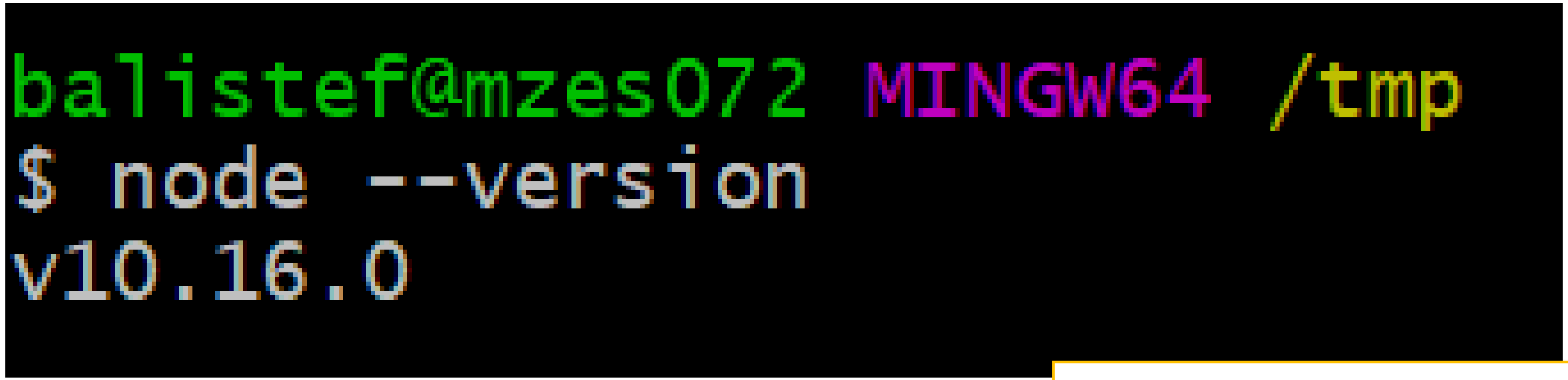
Installing and Launching nodeGame

Finally…

Installing NodeGame

Go the directory where you have downloaded the nodegame installer

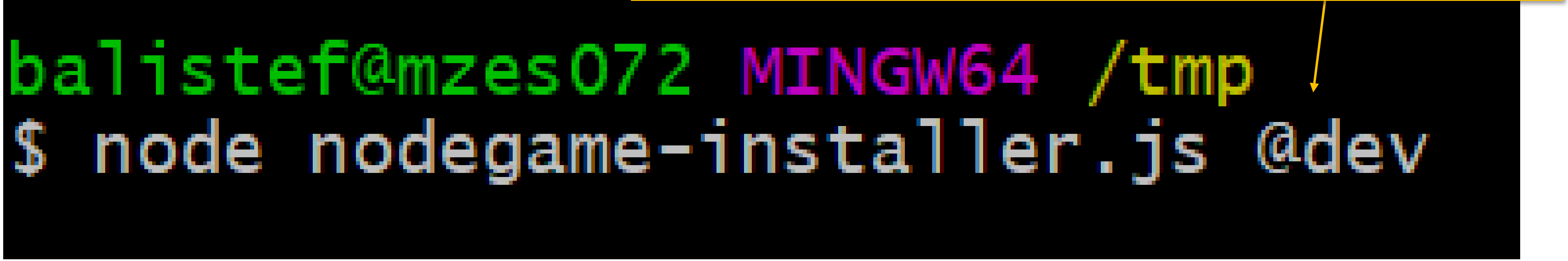
Check that Node.JS is correctly installed (version > 10)



```
balistef@mzes072 MINGW64 /tmp
$ node --version
v10.16.0
```

Install nodeGame

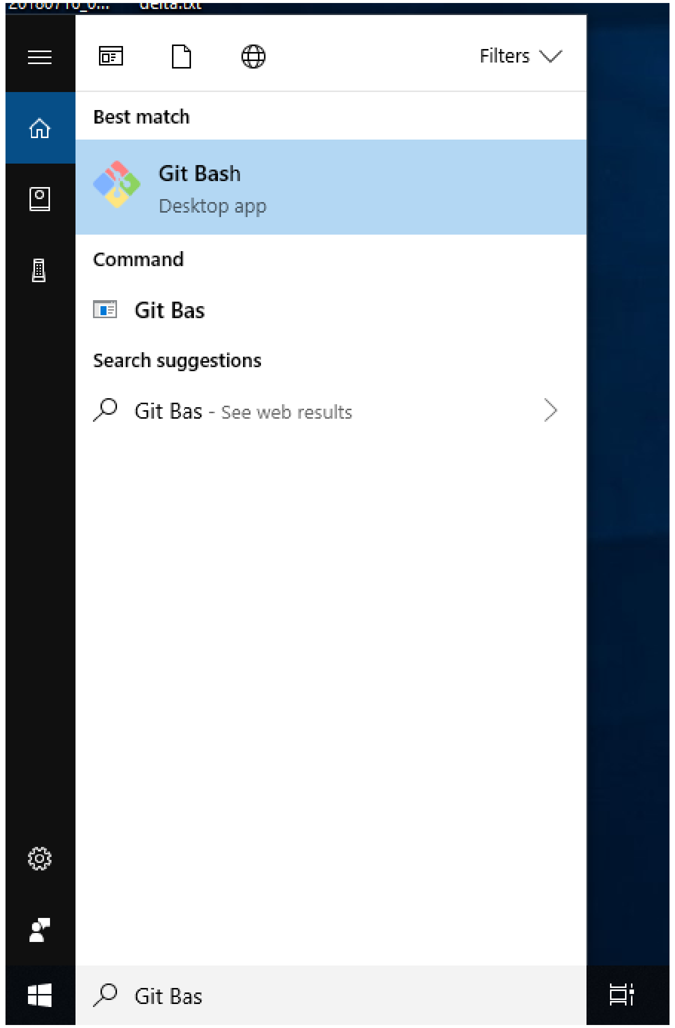
@dev is important to install the latest features that will use in this class

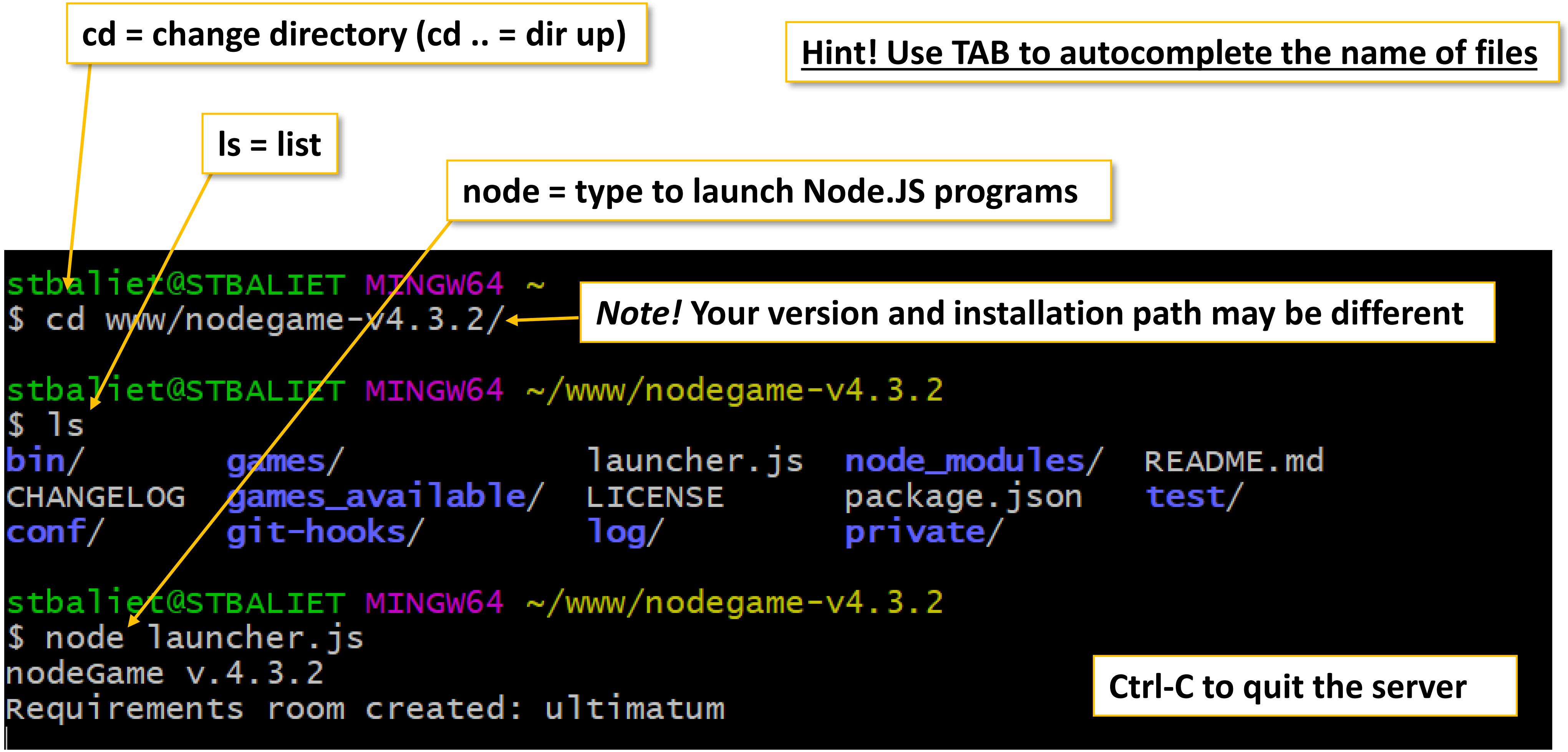


```
balistef@mzes072 MINGW64 /tmp
$ node nodegame-installer.js @dev
```

Launching nodeGame

- Go to the directory where you installed nodeGame and launch it





```
stbaliet@STBALIET MINGW64 ~
$ cd www/nodegame-v4.3.2/

stbaliet@STBALIET MINGW64 ~/www/nodegame-v4.3.2
$ ls
bin/        games/            launcher.js  node_modules/  README.md
CHANGELOG   games_available/  LICENSE      package.json   test/
conf/       git-hooks/        log/         private/

stbaliet@STBALIET MINGW64 ~/www/nodegame-v4.3.2
$ node launcher.js
nodeGame v.4.3.2
Requirements room created: ultimatum
```

cd = change directory (cd .. = dir up)

ls = list

node = type to launch Node.JS programs

Hint! Use TAB to autocomplete the name of files

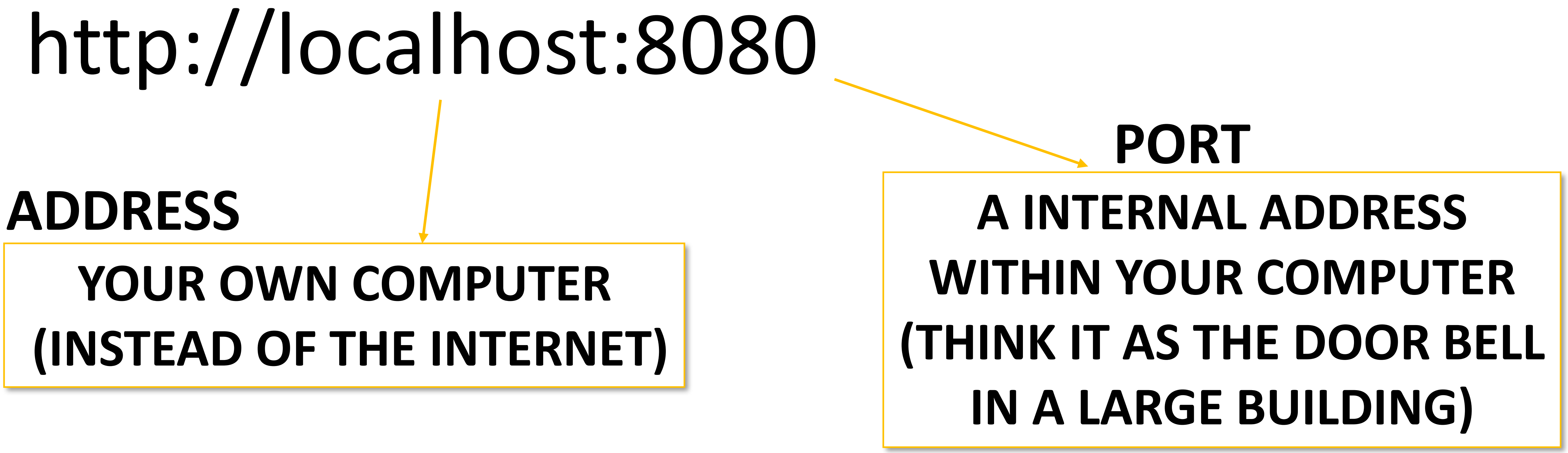
Note! Your version and installation path may be different

Ctrl-C to quit the server

The localhost Address

- After you launched nodeGame with command: node launcher.js

open your browser at the address:



http://localhost:8080

ADDRESS

YOUR OWN COMPUTER
(INSTEAD OF THE INTERNET)

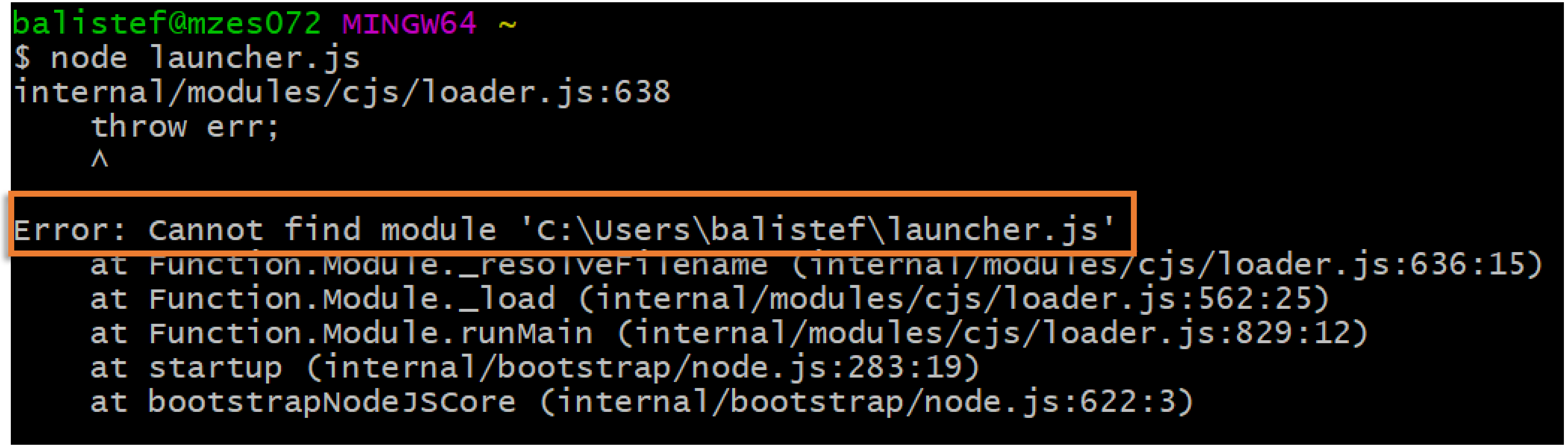
PORT

A INTERNAL ADDRESS
WITHIN YOUR COMPUTER
(THINK IT AS THE DOOR BELL
IN A LARGE BUILDING)

Locating the Installation Directory Again

Aah you closed the terminal…

A Common Error: Cannot Find Launcher



```
balistef@mzes072 MINGW64 ~
$ node launcher.js
internal/modules/cjs/loader.js:638
    throw err;
    ^

Error: Cannot find module 'C:\Users\balistef\launcher.js'
    at Function.Module._resolveFilename (internal/modules/cjs/loader.js:636:15)
    at Function.Module._load (internal/modules/cjs/loader.js:562:25)
    at Function.Module.runMain (internal/modules/cjs/loader.js:829:12)
    at startup (internal/bootstrap/node.js:283:19)
    at bootstrapNodeJSCore (internal/bootstrap/node.js:622:3)
```

This means that you are not inside the nodeGame directory.

Let's understand how to get in there.

The Terminal

Locate your nodeGame installation folder with Git Bash

1. Open Git Bash
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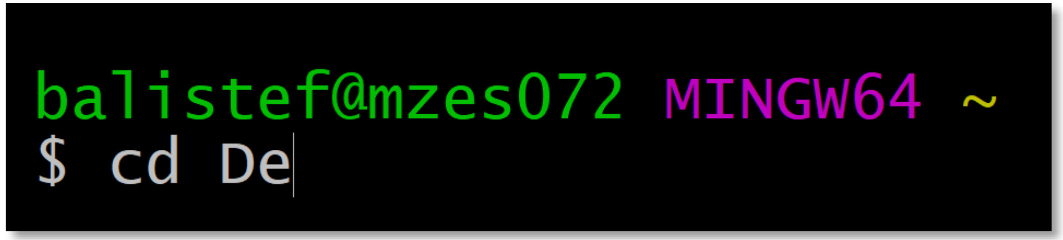
4. Enter the nodeGame installation directory. *How?* Let's assume you saved it on your desktop.

Begin Typing…



```
balistef@mzes072 MINGW64 ~
$ cd De
```

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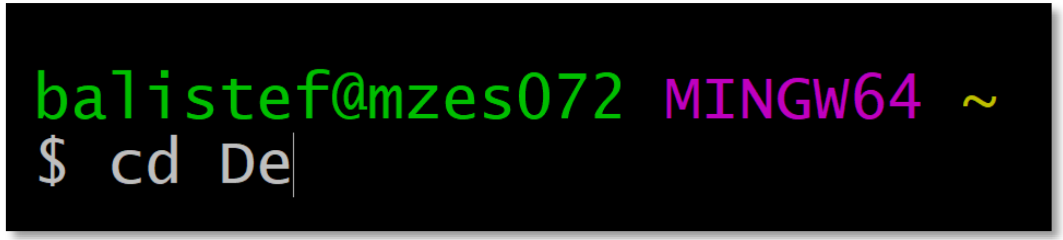

```
balistef@mzes072 MINGW64 ~
$ cd De
```

Press the TAB key for autocomplete

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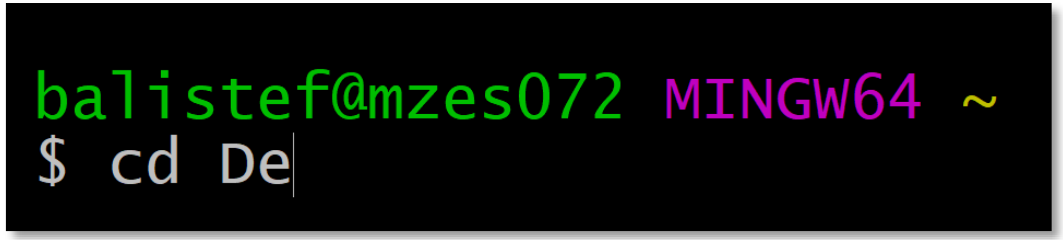
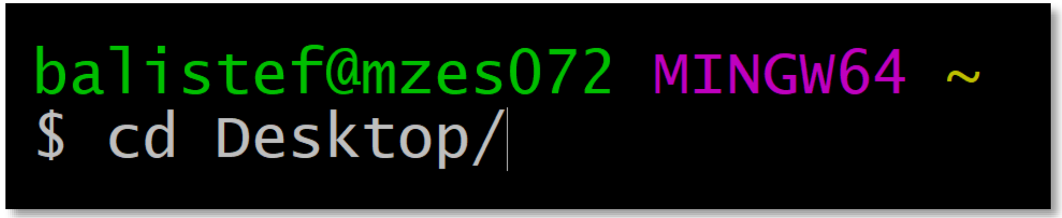


```
balistef@mzes072 MINGW64 ~
$ cd De
```

TA DA!



```
balistef@mzes072 MINGW64 ~
$ cd Desktop/
```

Press the TAB key for autocomplete

When should I use TAB and when should I type directly?

The Terminal

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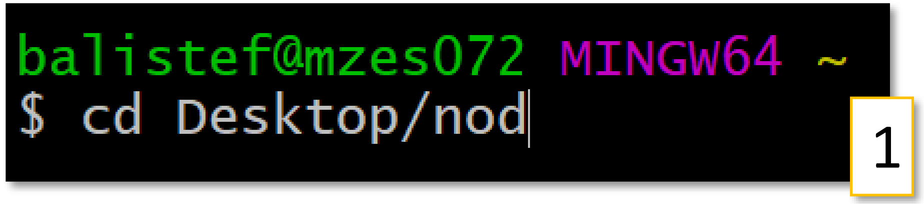

```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nod
```

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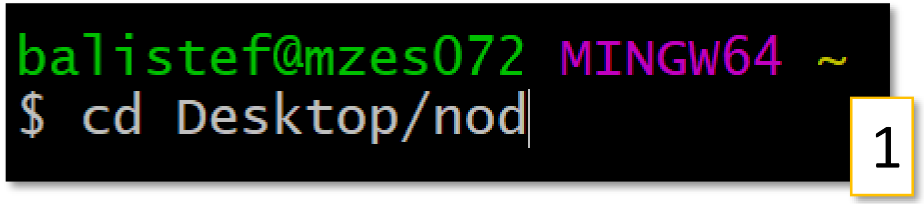
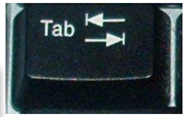
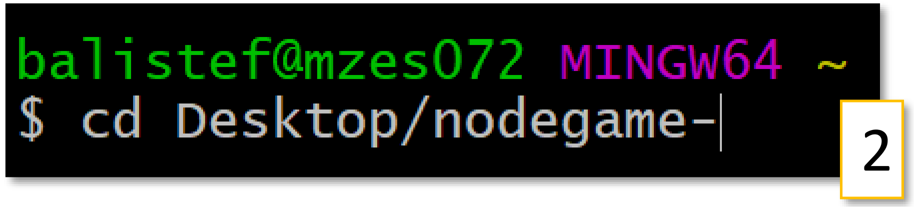


```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nod
```

1





```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-
```

2

The Terminal

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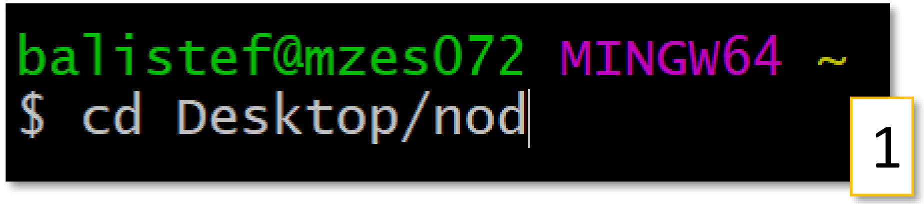
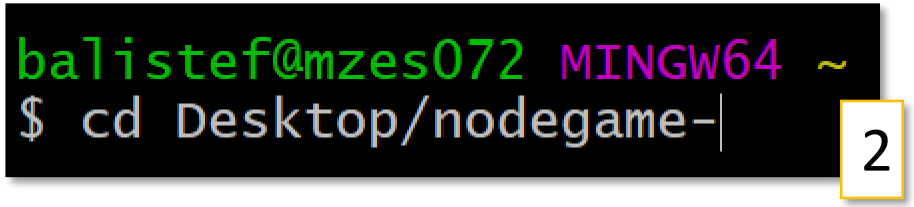


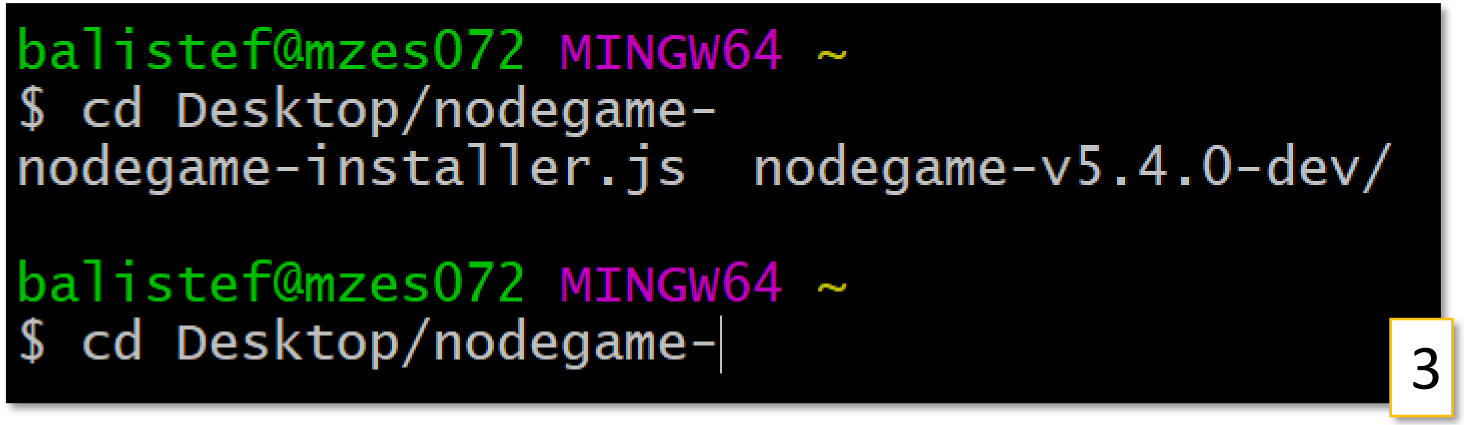
```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nod
```

1



```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-
```

2



```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-
nodegame-installer.js  nodegame-v5.4.0-dev/

balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-
```

3

The Terminal

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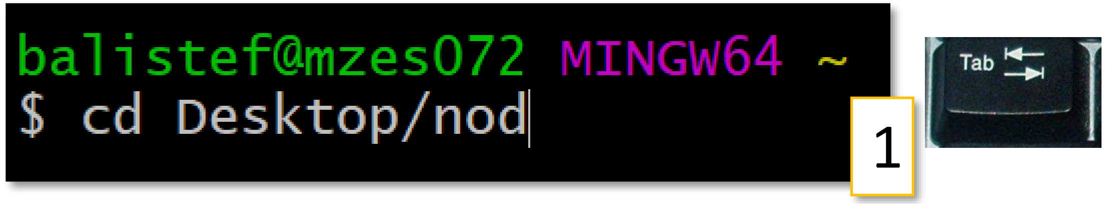
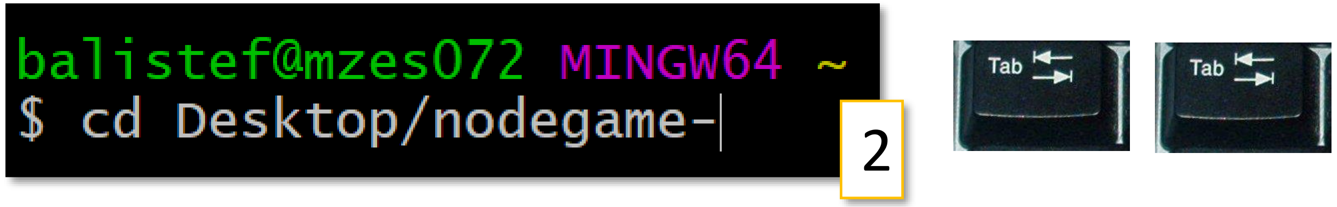


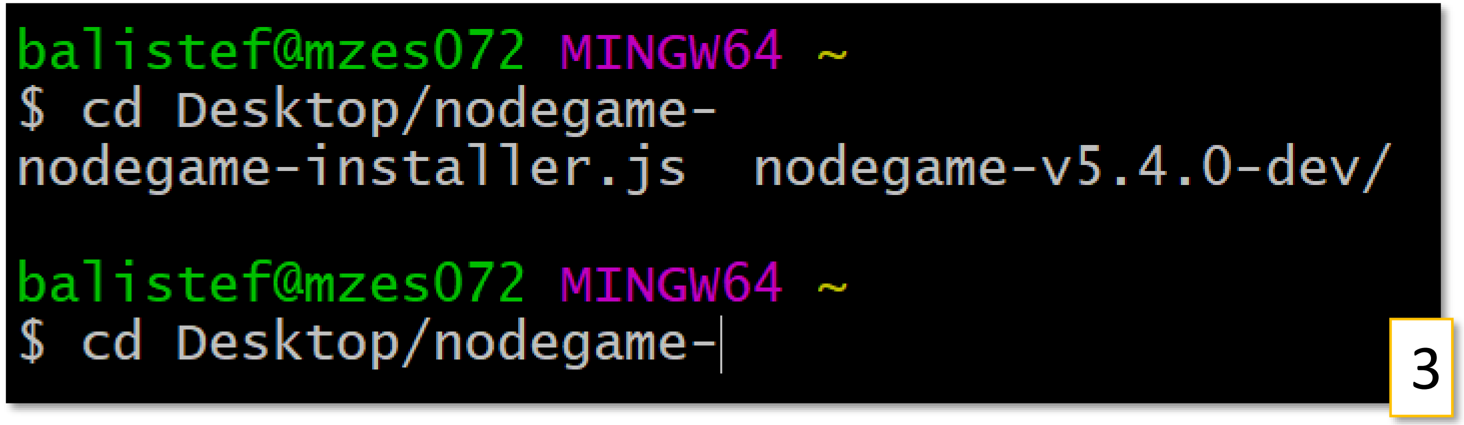
```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nod
```

1



```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-
```

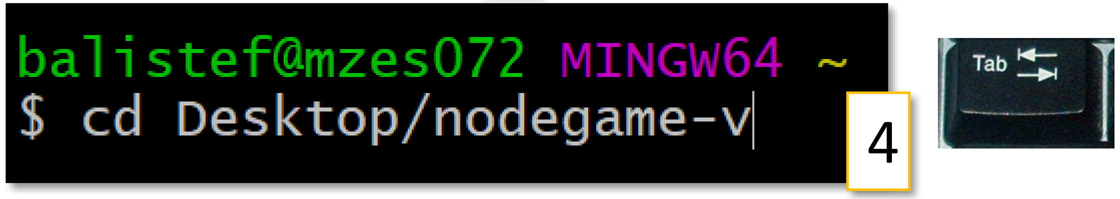
2



```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-
nodegame-installer.js  nodegame-v5.4.0-dev/

balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-
```

3



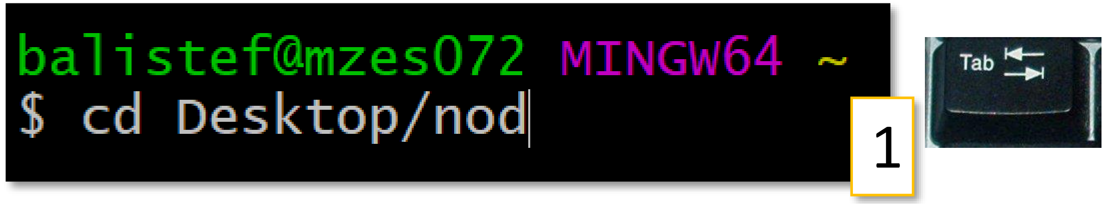
```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-v
```

4

The Terminal

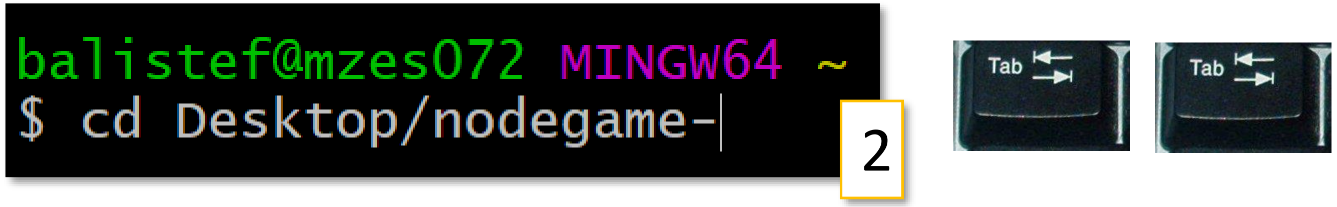
Locate your nodeGame installation folder with Git Bash

1. Open Git Bash
2. *As you know from the previous slides*, you might either be in your **home folder** or in **top directory**.
3. If you are in top directory (or any other), *how do you get back to your home directory*?
4. Enter the nodeGame installation directory. *How?* Let's assume you saved it on your desktop.



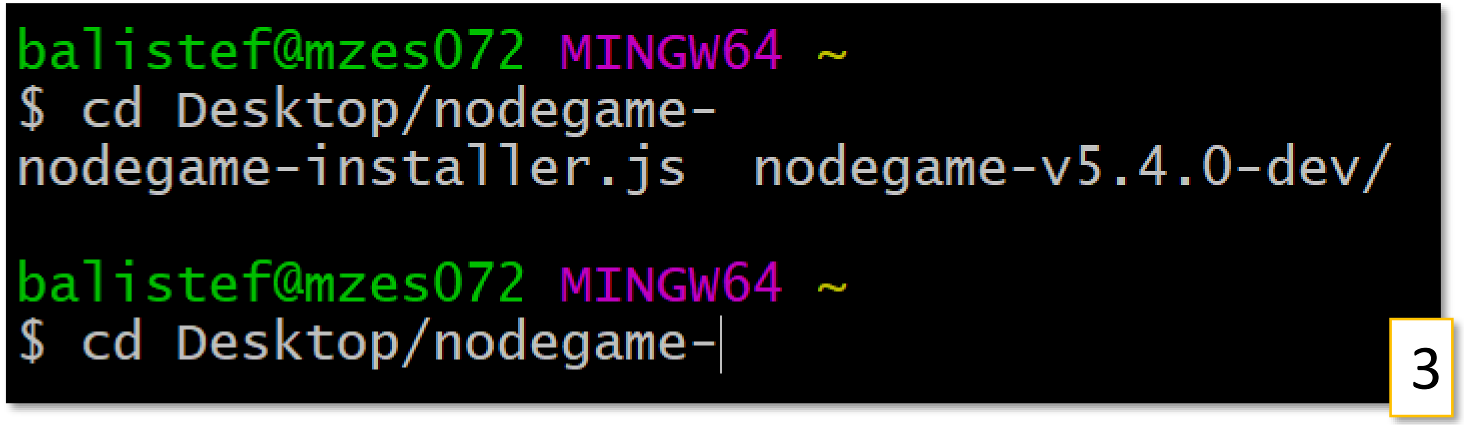
1

```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nod
```



2

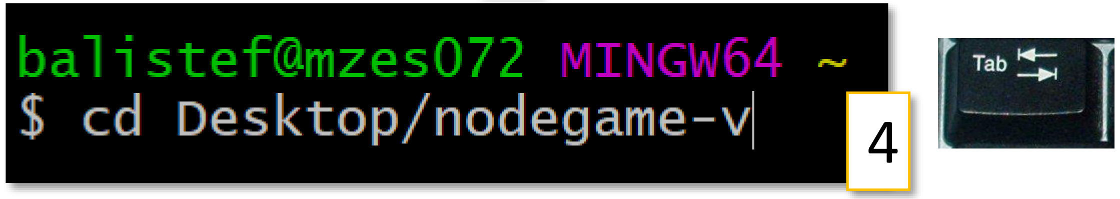
```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-
```



3

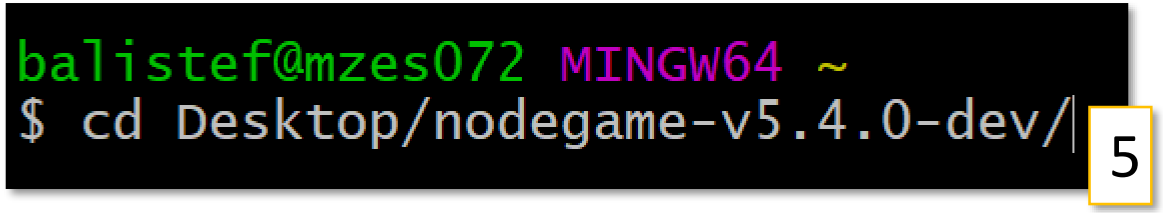
```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-
nodegame-installer.js  nodegame-v5.4.0-dev/

balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-
```



4

```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-v
```



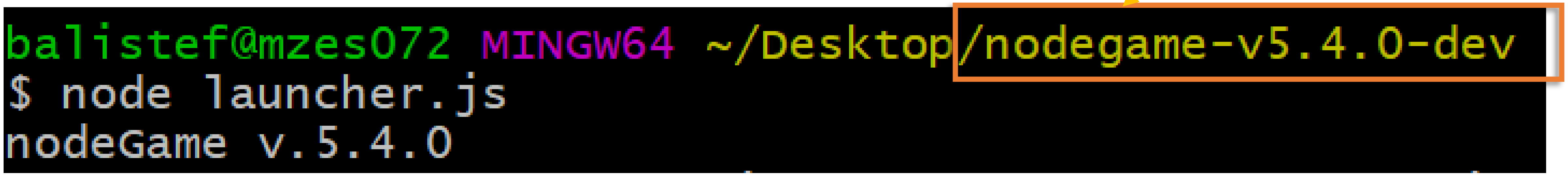
5

```
balistef@mzes072 MINGW64 ~
$ cd Desktop/nodegame-v5.4.0-dev/
```

The Terminal

Locate your nodeGame installation folder with Git Bash

1. Open Git Bash
2. *As you know from the previous slides*, you might either be in your **home folder** or in **top directory**.
3. If you are in top directory (or any other), *how do you get back to your home directory*?
4. Enter the nodeGame installation directory. *How?* Let's assume you saved it on your desktop.
5. You can now safely start nodeGame



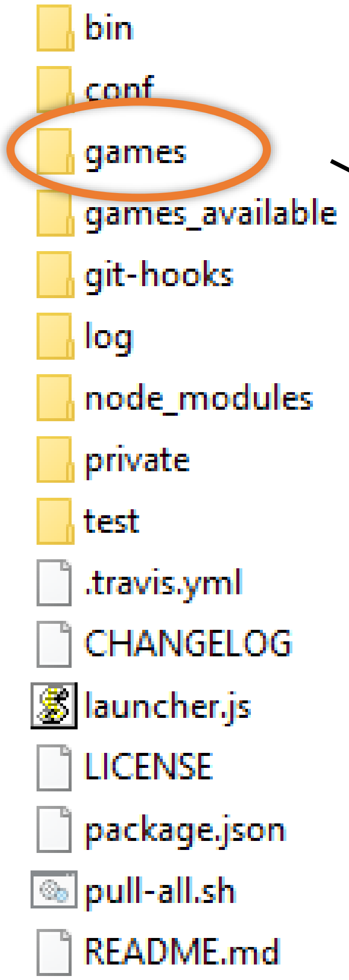
```
balistef@mzes072 MINGW64 ~/Desktop/nodegame-v5.4.0-dev
$ node launcher.js
nodeGame v.5.4.0
```

Tells you that you are in the right folder

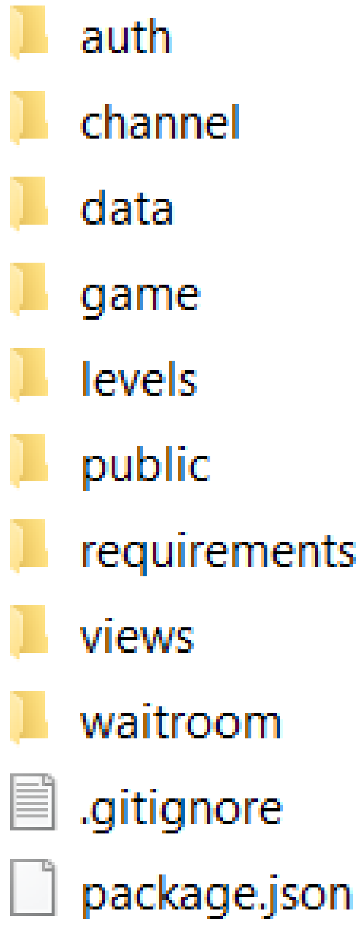
A First Look into nodeGame

Games/

Let's look inside the installation directory, and let's locate the ultimatum game



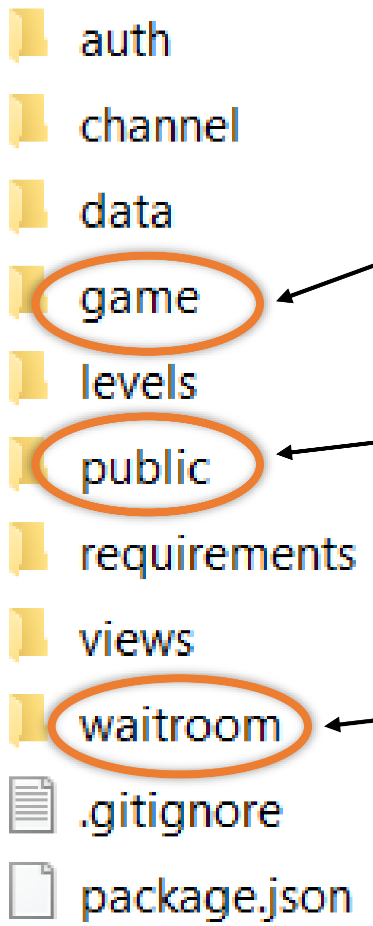
bin
conf
games
games_available
git-hooks
log
node_modules
private
test
.travis.yml
CHANGELOG
launcher.js
LICENSE
package.json
pull-all.sh
README.md



auth
channel
data
game
levels
public
requirements
views
waitroom
.gitignore
package.json

Game’s Anatomy

Configuration and game files are separated in different folder



auth
channel
data
game
levels
public
requirements
views
waitroom
.gitignore
package.json

game:

- Define treatments
- Define the sequence of stages and steps of the experiment
- Implement the rules of interactions among participants
- General setup

public:

- Define the graphical contents of the game

waitroom:

- Define the rules about how to assign treatments to game rooms, and participants to treatments

Hands On 3: Folder waitroom/

Waiting-Room-v4

Change waiting room options

Start 2 groups simultaneously with random treatment assignment (hint: POOL_SIZE)

waitroom.settings.js

```
// How many clients must connect before groups are formed
POOL_SIZE: 2,

// The size of each group
GROUP_SIZE: 2,
```

A larger pool size allows you to:

- Reshuffle groups after each experiment
- Ensure that randomization is effective (e.g., distribute fast participants across treatments, or other forms of stratified assignment).

Hands On 3: Folder waitroom/

Waiting-Room-v4

Change waiting room options

Remove Select Treatments button

waitroom.settings.js

```
// Display buttons to play with bots and select treatment
ALLOW_PLAY_WITH_BOTS: true,
ALLOW_SELECT_TREATMENT: false,
```

Hands On 4: Reading Errors

- Change waiting room options
  - Start 2 groups simultaneously with random treatment assignment (hint: POOL_SIZE),
  - Remove Select Treatments button

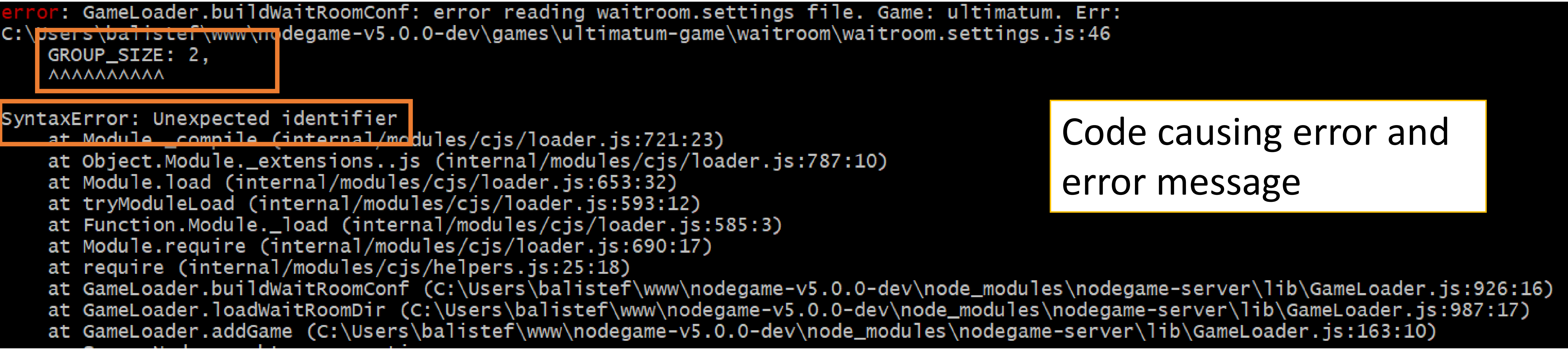
waitroom.settings.js

```
// How many clients must connect before groups are formed
POOL_SIZE: 2,

// The size of each group
GROUP_SIZE: 2,
```

We are modifying an object, and commas separate properties in objects. Remove the comma, and **let's learn how to read errors in Node.JS.**

Hands On 4: Reading Errors

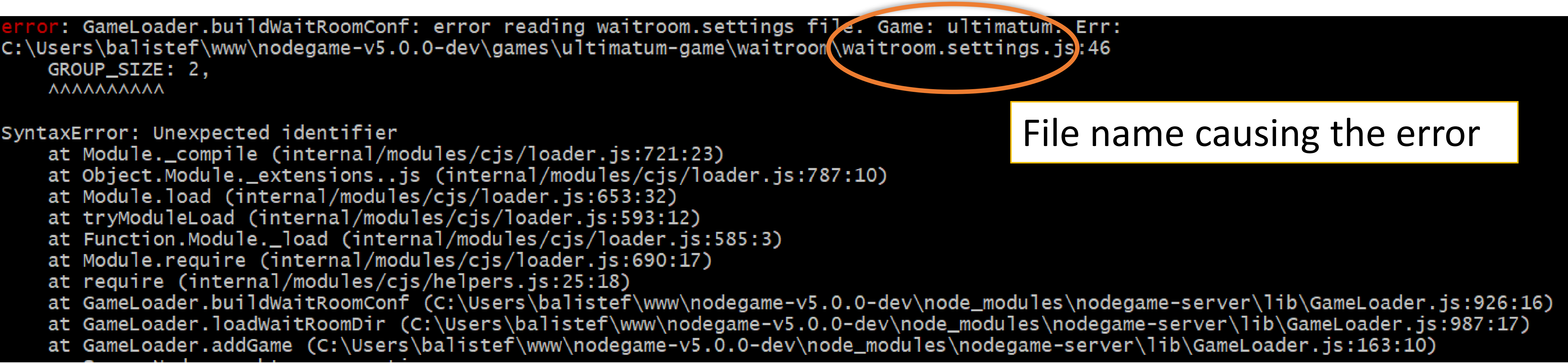


```
error: GameLoader.buildWaitRoomConf: error reading waitroom.settings file. Game: ultimatum. Err:
C:\Users\balistef\www\nodegame-v5.0.0-dev\games\ultimatum-game\waitroom\waitroom.settings.js:46
    GROUP_SIZE: 2,
    ^^^^^^^^^^

SyntaxError: Unexpected identifier
    at Module._compile (internal/modules/cjs/loader.js:721:23)
    at Object.Module._extensions..js (internal/modules/cjs/loader.js:787:10)
    at Module.load (internal/modules/cjs/loader.js:653:32)
    at tryModuleLoad (internal/modules/cjs/loader.js:593:12)
    at Function.Module._load (internal/modules/cjs/loader.js:585:3)
    at Module.require (internal/modules/cjs/loader.js:690:17)
    at require (internal/modules/cjs/helpers.js:25:18)
    at GameLoader.buildWaitRoomConf (C:\Users\balistef\www\nodegame-v5.0.0-dev\node_modules\nodegame-server\lib\GameLoader.js:926:16)
    at GameLoader.loadWaitRoomDir (C:\Users\balistef\www\nodegame-v5.0.0-dev\node_modules\nodegame-server\lib\GameLoader.js:987:17)
    at GameLoader.addGame (C:\Users\balistef\www\nodegame-v5.0.0-dev\node_modules\nodegame-server\lib\GameLoader.js:163:10)
```

Code causing error and error message

Hands On 4: Reading Errors



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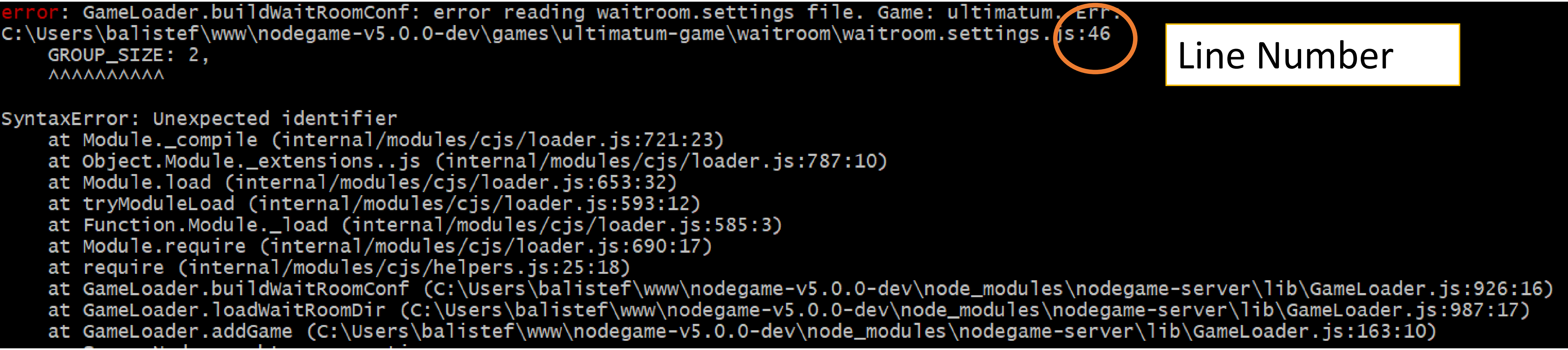
    at GameLoader.addGame (C:\Users\balistef\www\nodegame-v5.0.0-dev\node_modules\nodegame-server\lib\GameLoader.js:163:10)
```

File name causing the error

Hands On 4: Reading Errors



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C:\Users\balistef\www\nodegame-v5.0.0-dev\games\ultimatum-game\waitroom\waitroom.settings.js:46
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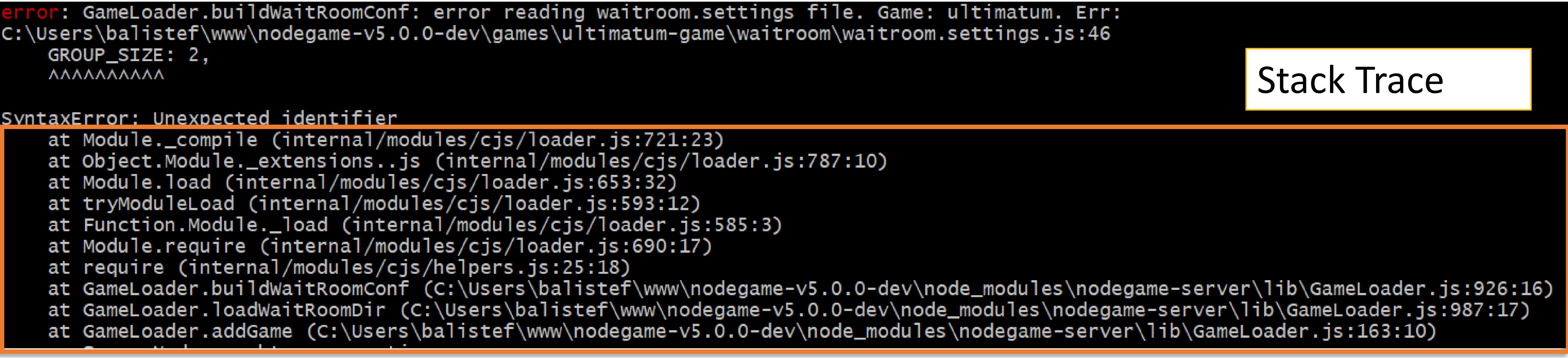
```

Line Number

Note! The line number is not always where the error actually lies. In fact, it is often on a subsequent line. Here, without the comma, the compiler does not even know that a line ended. When you forget a parenthesis, the errored line number can be the last line of the file, which makes it very difficult to find the error's actual position.

Hands On 4: Reading Errors

Waiting-Room-v4



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C:\Users\balistef\www\nodegame-v5.0.0-dev\games\ultimatum-game\waitroom\waitroom.settings.js:46
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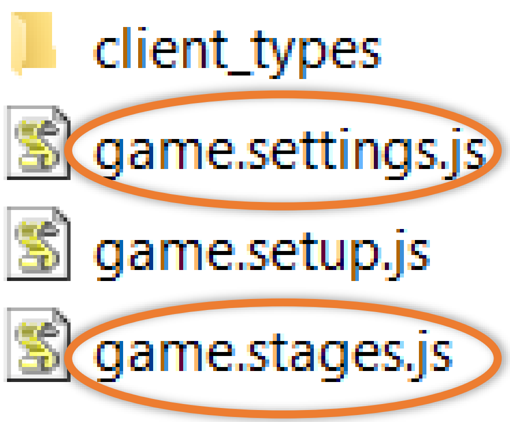
```

Stack Trace

Stack Trace: the stack trace contains all the functions calls until the error happened. *You can generally ignore this part.*

https://en.wikipedia.org/wiki/Stack_trace

Folder game/



client_types

game.settings.js

game.setup.js

game.stages.js

Define game variables and group them into treatments

Define the sequence of stages and steps of the experiment

Stages Definition

Stager-API-v4

game.stages.js

We use the stager API to define the sequence (the order matters here!)

A sequence contains stages, and stages contain steps

```
stager
    .next('id_of_stage')

stager
    .step('id_of_step1_within_stage')
    .step('id_of_step2_within_stage')

stager
    .repeat('id_stage_to_repeat', 3)
```

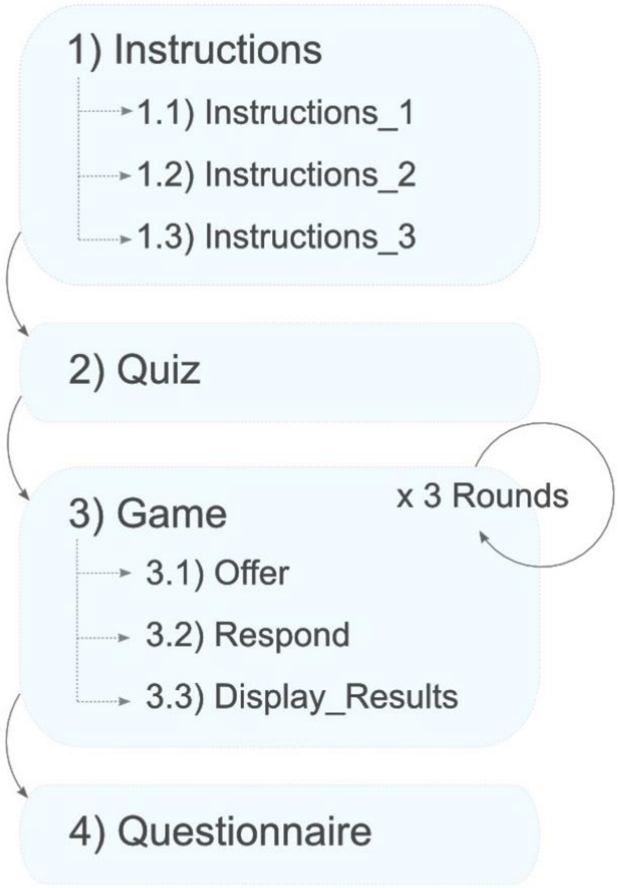
Here, we "chain" two method calls together. We can do it, because each method is returning a `stager` object, so it is a more compact way of writing:

```
stager.step('id_of_step1_within_stage');
stager.step('id_of_step2_within_stage');
```

Stages Definition

Stager-API-v4

Game Sequence



1) Instructions
- 1.1) Instructions_1
- 1.2) Instructions_2
- 1.3) Instructions_3

2) Quiz

3) Game x 3 Rounds
- 3.1) Offer
- 3.2) Respond
- 3.3) Display_Results

4) Questionnaire

Code Snippet

```
stager.stage("instructions")
      .step("instructions_1")
      .step("instructions_2")
      .step("instructions_3");

stager.stage("quiz");

stager.repeat("game", 3)

stager.stage("questionnaire");

stager.extendStage("game", {
    steps: [ "offer",
             "respond",
             "display_results" ]
});
```

Hands On 4

- Skip some stages of the game sequence (very useful for debugging)

game.stages.js

```
// Skip stages from the sequence.
stager.skip('precache');
stager.skip('selectLanguage');
stager.skip('quiz');
stager.skip('instructions');
stager.skip('mood');
```