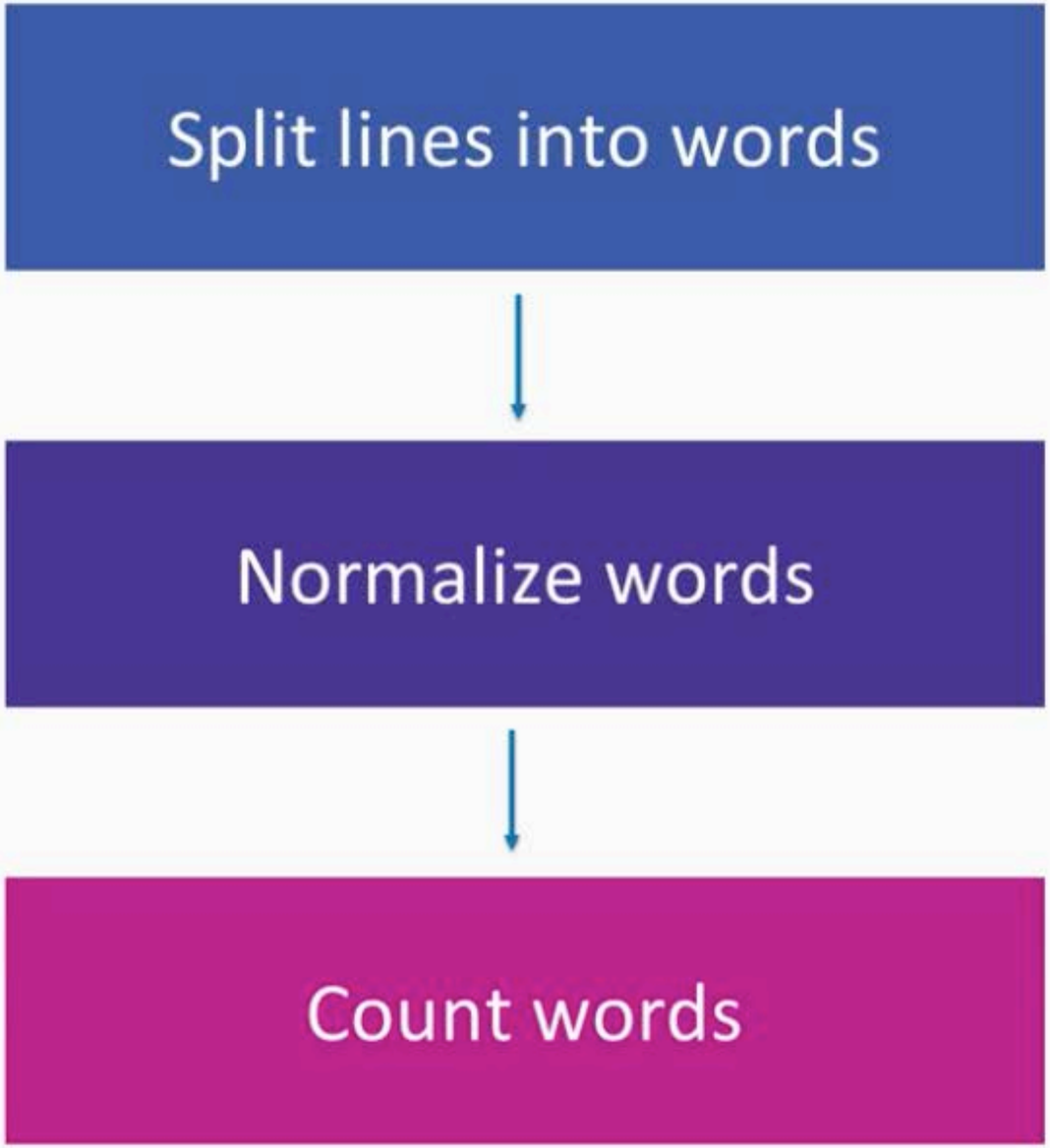
Streams

Streams

- Are lazy Enumerables
- Composing streams creates recipes rather than immediate results
- Useful for processing large or infinite data sets efficiently

Word Counting

Given a list of lines, count the occurrence of all words.



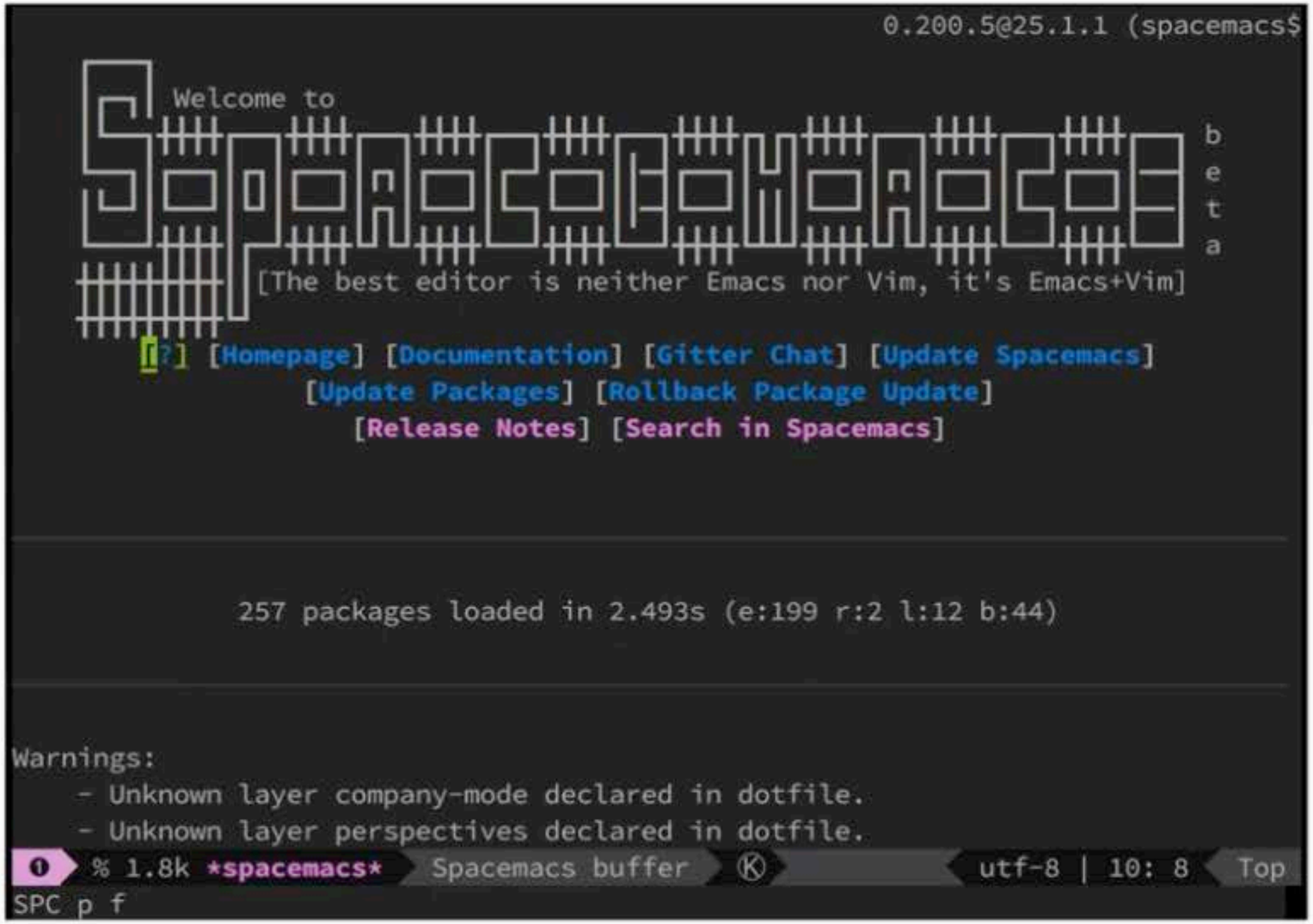
Word Counting

Given a list of lines, count the occurrence of all words.

```
➜  Projects mix new words
* creating README.md
* creating .gitignore
* creating mix.exs
* creating config
* creating config/config.exs
* creating lib
* creating lib/words.ex
* creating test
* creating test/test_helper.exs
* creating test/words_test.exs

Your Mix project was created successfully.
You can use "mix" to compile it, test it, and more:

    cd words
    mix test

Run "mix help" for more commands.
➜  Projects cd words
➜  words em
```

Word Counting

Given a list of lines, count the occurrence of all words.



Word Counting

Given a list of lines, count the occurrence of all words.

```
defmodule Words do
  @moduledoc """
  Documentation for Words.
  """

  @doc """
  Hello world.

  ## Examples

      iex> Words.hello
      :world

  """
  def hello do
    :world
  end
end
```

1 - 191 words.ex Elixir alchemist ⓥⓢⓟⓐⓚ unix | 1: 0 All
Beginning of buffer

Word Counting

Given a list of lines, count the occurrence of all words.

```
defmodule Words do

end
```

```
1  * 26 words.ex  Elixir  alchemist ⓨⓢⓟⓐⓚ  unix | 2: 2  All
-- INSERT --
```

Word Counting

Given a list of lines, count the occurrence of all words.

```
defmodule Words do
  def count(lines) do
    lines
    |> Enum.flat_map(&String.split/1)
    |> Enum.map(&String.downcase/1)
    |> Enum.map(&remove_special_chars/1)
    |> Enum.reduce(%{}, &count_word/2)
  end

  defp remove_special_chars(string) do
    string
    |> String.normalize(:nfd)
    |> String.replace(~r/[^A-z\s]/u, "")
  end

  defp count_word(word, map) do
    Map.update(map, word, 1, &(&1 + 1))
  end
end
```

```
1  * 422 words.ex  Elixir  alchemist ⓨⓢⓟⓐⓚ        unix | 18: 4  All
:wq
```

Word Counting

Given a list of lines, count the occurrence of all words.

```
* creating lib
* creating lib/words.ex
* creating test
* creating test/test_helper.exs
* creating test/words_test.exs

Your Mix project was created successfully.
You can use "mix" to compile it, test it, and more:

    cd words
    mix test

Run "mix help" for more commands.
➜  Projects cd words
➜  words emacs -nw
➜  words iex -S mix
Erlang/OTP 19 [erts-8.2] [source] [64-bit] [smp:8:8] [async-threads:10] [hipe] [
kernel-poll:false] [dtrace]

Compiling 1 file (.ex)
Generated words app
Interactive Elixir (1.4.2) - press Ctrl+C to exit (type h() ENTER for help)
iex(1)> Words.count(["a", "a a a", "b a"])
%{"a" => 5, "b" => 1}
iex(2)>
```

Word Counting

Given a list of lines, count the occurrence of all words.

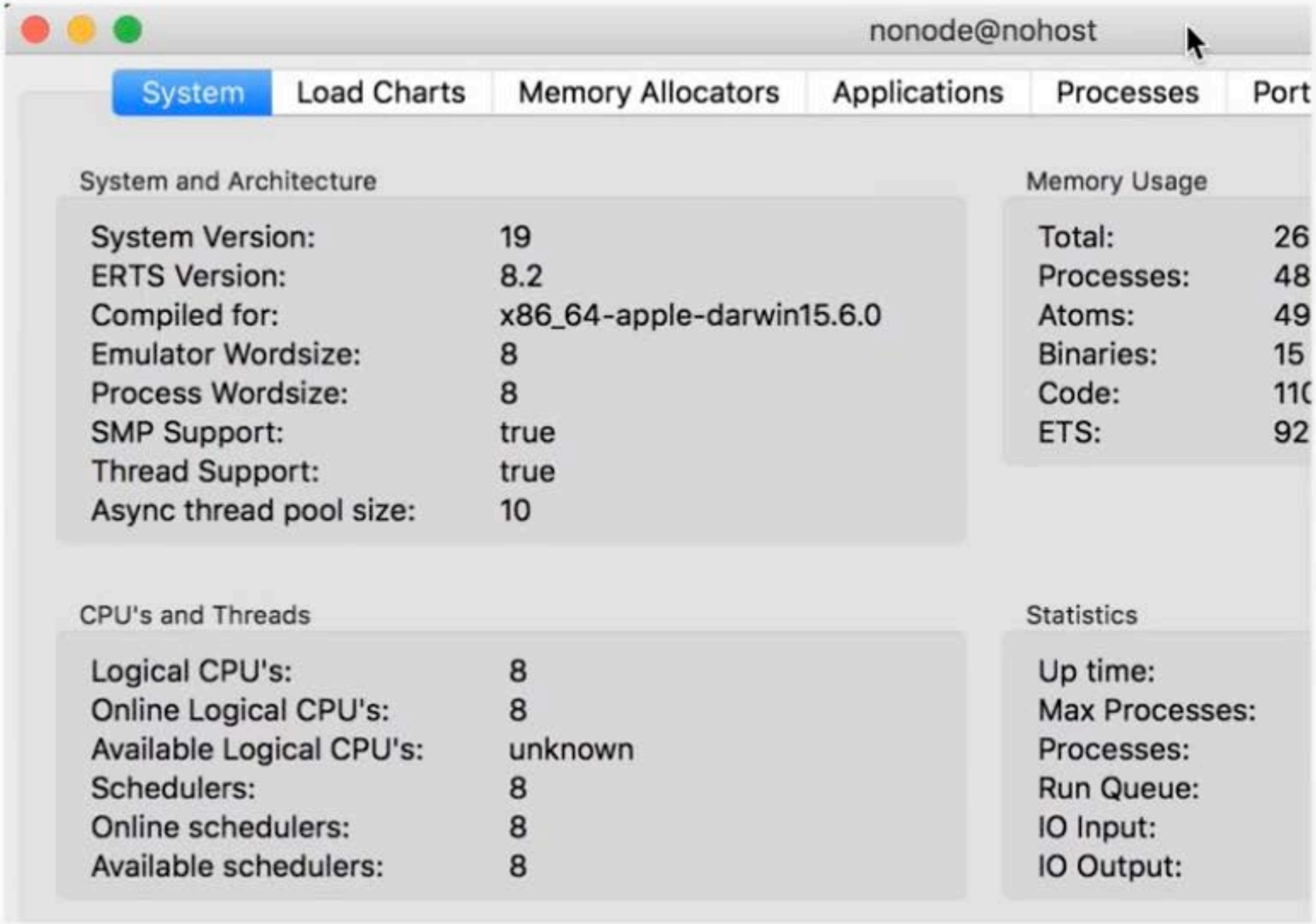
Getting “War and Peace” and trying it out!

```
➜ words iex -S mix
Erlang/OTP 19 [erts-8.2] [source] [64-bit] [smp:8:8] [async-threads:10] [hipe] [
kernel-poll:false] [dtrace]

Interactive Elixir (1.4.2) - press Ctrl+C to exit (type h() ENTER for help)
iex(1)> :observer.start
```

Word Counting

Given a list of lines, count the occurrence of all words.

Getting “War and Peace” and trying it out!



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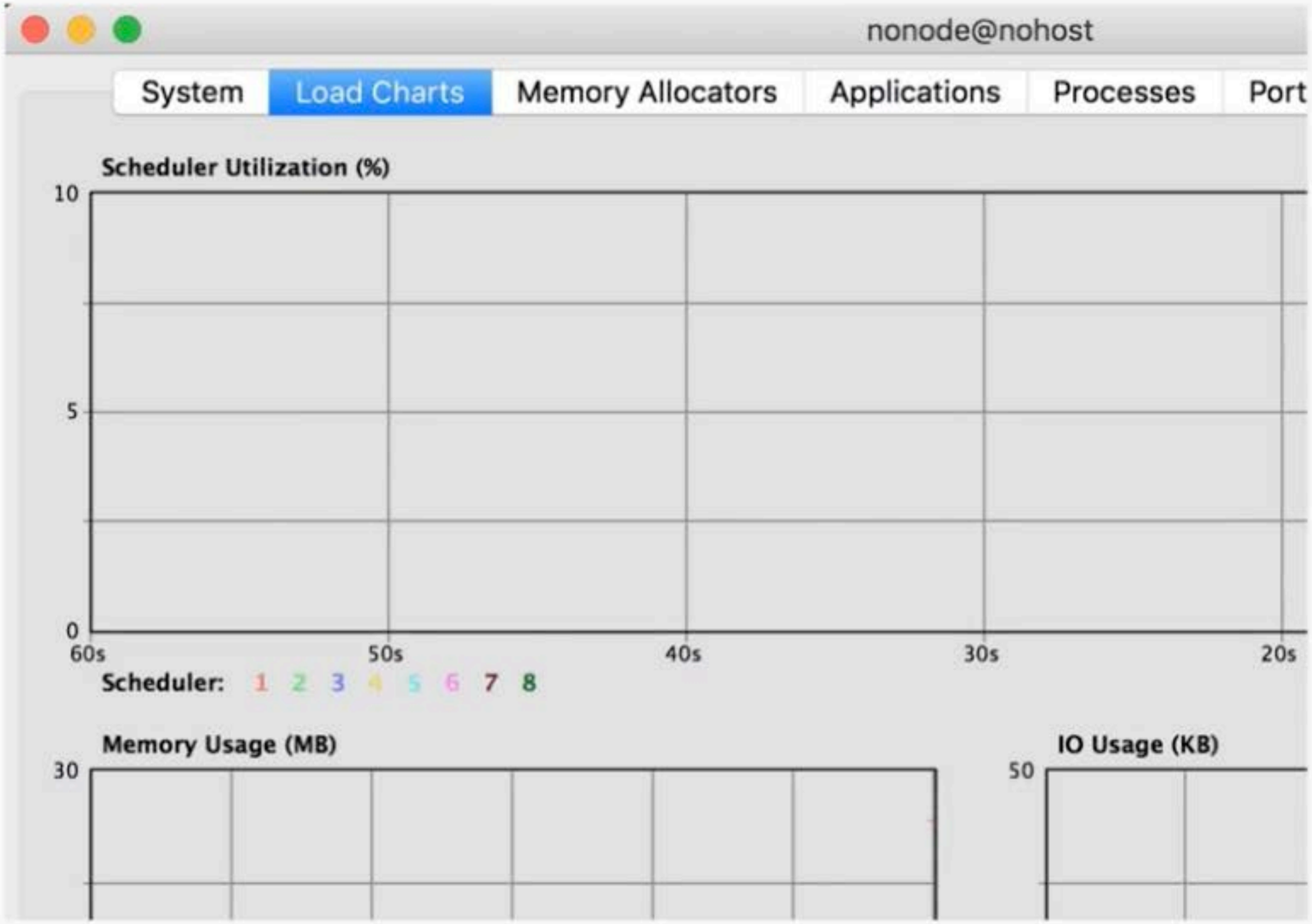

Word Counting

Given a list of lines, count the occurrence of all words.

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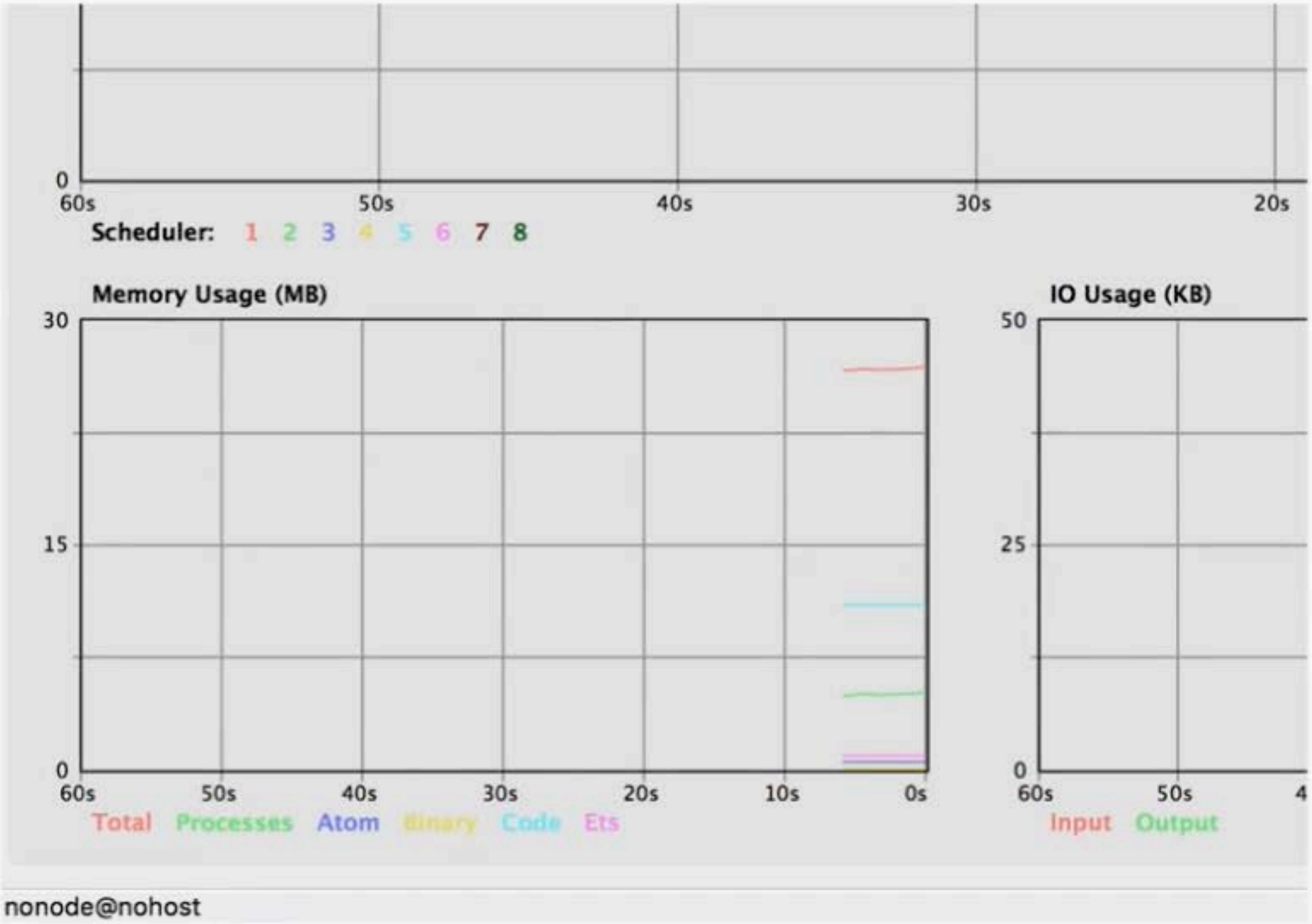

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kernel-poll:false] [dtrace]

Interactive Elixir (1.4.2) - press Ctrl+C to exit (type h() ENTER for help)
iex(1)> :observer.start
:ok
iex(2)> Words.count(File.stream!("war_and_peace.txt"))
```

Word Counting

Given a list of lines, count the occurrence of all words.

Getting “War and Peace” and trying it out!

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Interactive Elixir (1.4.2) - press Ctrl+C to exit (type h() ENTER for help)
iex(1)> :observer.start
:ok
iex(2)> Words.count(File.stream!("war_and_peace.txt"))
%{"annihilated" => 1, "sedateness" => 1, "citizens" => 6, "roots" => 1,
  "dissect" => 1, "destroys" => 2, "attempting" => 2, "reminder" => 4,
  "supervision" => 1, "ledge" => 4, "bandy" => 3, "handleless" => 1,
  "onelet" => 1, "injunction" => 1, "warlike" => 7, "affably" => 1, "txt" => 1,
  "incursions" => 1, "walnuts" => 1, "executed" => 32, "silent" => 164,
  "vessel" => 3, "ordering" => 4, "contemplation" => 3, "pillagedthey" => 1,
  "hunting" => 23, "tawny" => 1, "krieg" => 1, "enjoined" => 1, "gervinus" => 2,
  "exceptional" => 8, "eventsagain" => 1, "disdaining" => 1, "refixing" => 1,
  "cease" => 24, "frederick" => 4, "convey" => 6, "woodcutting" => 1,
  "resentment" => 2, "debonair" => 1, "pounced" => 3, "selfwill" => 1,
  "caressing" => 9, "inappropriate" => 1, "nods" => 2, "mamene" => 1,
  "oudinots" => 1, "zherkov" => 37, "dappled" => 1, "efficiency" => 1, ...}
iex(3)>
```

It uses too much memory!

~160 MB

Why?

Because of intermediate representations

- Each step of the computation outputs a copy of the enumerable
- With big data sets, this becomes unfeasible

Word Counting v2

Given a list of lines, count the occurrence of all words.

Using streams for the intermediate steps.

```elixir
defmodule Words do
  def count(lines) do
    lines
    |> Enum.flat_map(&String.split/1)
    |> Enum.map(&String.downcase/1)
    |> Enum.map(&remove_special_chars/1)
    |> Enum.reduce(%{}, &count_word/2)
  end

  defp remove_special_chars(string) do
    string
    |> String.normalize(:nfd)
    |> String.replace(~r/[^A-z\s]/u, "")
  end

  defp count_word(word, map) do
    Map.update(map, word, 1, &(&1 + 1))
  end
end
```

1 - 422 words.ex Elixir alchemist ⓨⓢⓟⓐⓚ unix | 1: 0 All

Word Counting v2

Given a list of lines, count the occurrence of all words.

Using streams for the intermediate steps.

```
defmodule Words do
  def count(lines, mod) do
    lines
    |> mod.flat_map(&String.split/1)
    |> mod.map(&String.downcase/1)
    |> mod.map(&remove_special_chars/1)
    |> Enum.reduce(%{}, &count_word/2)
  end

  defp remove_special_chars(string) do
    string
    |> String.normalize(:nfd)
    |> String.replace(~r/[^A-z\s]/u, "")
  end

  defp count_word(word, map) do
    Map.update(map, word, 1, &(&1 + 1))
  end
end
```

```
- 424 words.ex   Elixir   alchemist ⓨⓢⓟⓐⓚ   unix | 8: 4   All
Saving file /Users/jpoverclock/.emacs.d/.cache/layouts/persp-auto-save...
```

Word Counting v2

Given a list of lines, count the occurrence of all words.

Using streams for the intermediate steps.

```
➜ words emacs -nw
➜ words iex -S mix
Erlang/OTP 19 [erts-8.2] [source] [64-bit] [smp:8:8] [async-threads:10] [hipe] [
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Compiling 1 file (.ex)
Interactive Elixir (1.4.2) - press Ctrl+C to exit (type h() ENTER for help)
iex(1)>
```

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Given a list of lines, count the occurrence of all words.

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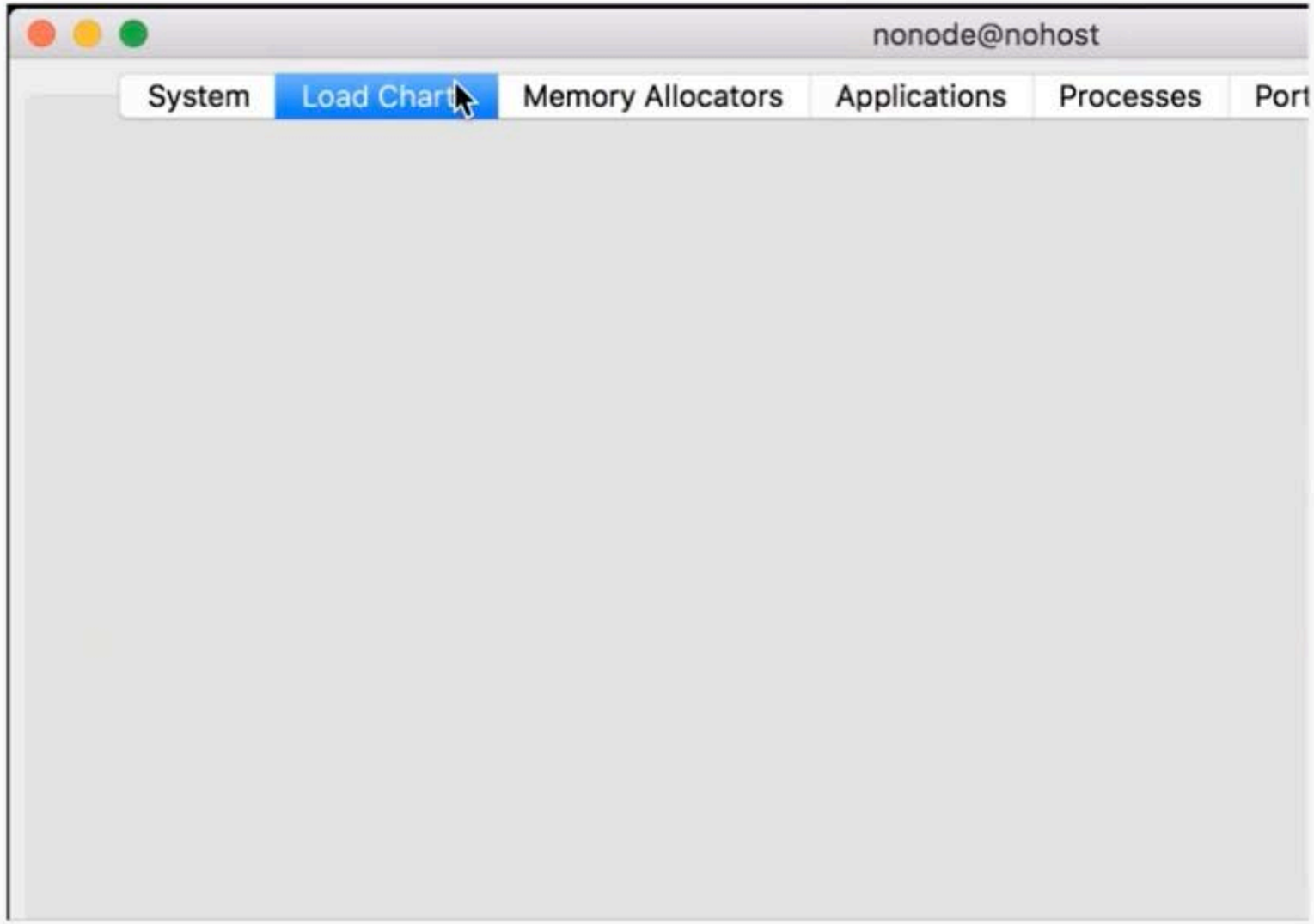

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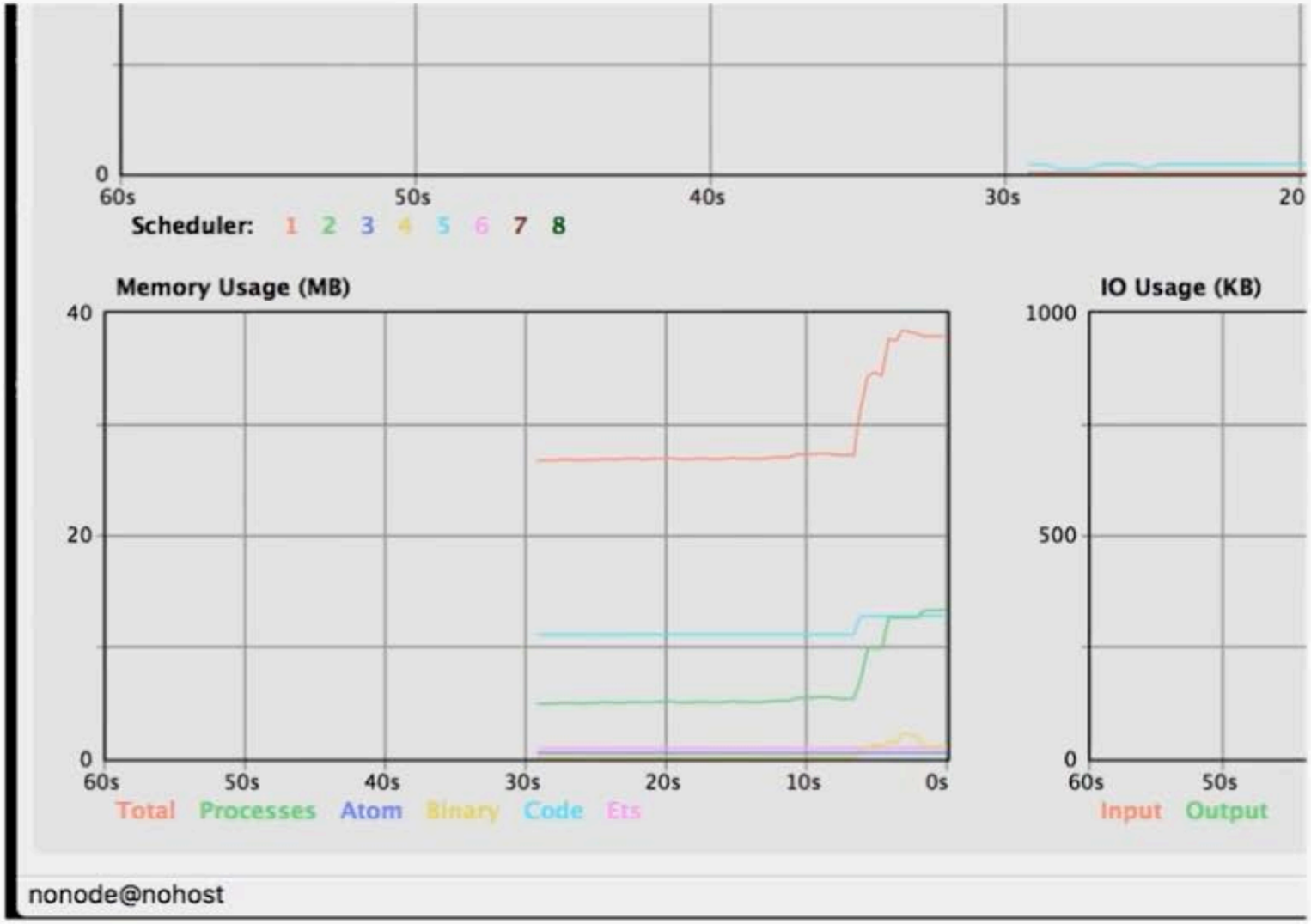
Compiling 1 file (.ex)
Interactive Elixir (1.4.2) - press Ctrl+C to exit (type h() ENTER for help)
iex(1)> :observer.start
:ok
iex(2)> Words.count(File.stream!("war_and_peace.txt"), Stream)
```

Word Counting v2

Given a list of lines, count the occurrence of all words.

Using streams for the intermediate steps.



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➜ words emacs -nw
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  "incursions" => 1, "walnuts" => 1, "executed" => 32, "silent" => 164,
  "vessel" => 3, "ordering" => 4, "contemplation" => 3, "pillagedthey" => 1,
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```

¼ Memory Usage

Computation is now clustered together, so intermediate representations are no longer an issue

Summary

- Explored Enumerables
- Discussed streams