Practical Optional Types for Clojure

Ambrose Bonnaire-Sergeant

Department of Computer Science
Indiana University

Outline

Outline

Make Titles Informative. Use Uppercase Letters.

Subtitles are optional.

- Use `itemize` a lot.
- Use very short sentences or short phrases.

Make Titles Informative.

You can create overlays...

- using the `pause` command:
  - First item.
  - Second item.
- using overlay specifications:
  - First item.
  - Second item.
- using the general `uncover` command:
  - First item.
  - Second item.

Make Titles Informative.

You can create overlays...

- using the `pause` command:
  - First item.
  - Second item.
- using overlay specifications:
  - First item.
  - Second item.
- using the general `uncover` command:
  - First item.
  - Second item.

Make Titles Informative.

You can create overlays...

- using the `pause` command:
  - First item.
  - Second item.
- using overlay specifications:
  - First item.
  - Second item.
- using the general `uncover` command:
  - First item.
  - Second item.

Make Titles Informative.

You can create overlays...

- using the `pause` command:
  - First item.
  - Second item.
- using overlay specifications:
  - First item.
  - Second item.
- using the general `uncover` command:
  - First item.
  - Second item.

Make Titles Informative.

You can create overlays...

- using the `pause` command:
  - First item.
  - Second item.
- using overlay specifications:
  - First item.
  - Second item.
- using the general `uncover` command:
  - First item.
  - Second item.

Make Titles Informative.

You can create overlays...

- using the `pause` command:
  - First item.
  - Second item.
- using overlay specifications:
  - First item.
  - Second item.
- using the general `uncover` command:
  - First item.
  - Second item.

What Are Prime Numbers?

Definition

A prime number is a number that has exactly two divisors.

Example

- 2 is prime (two divisors: 1 and 2).
- 3 is prime (two divisors: 1 and 3).
- 4 is not prime (three divisors: 1, 2, and 4).

What Are Prime Numbers?

Definition

A prime number is a number that has exactly two divisors.

Example

- 2 is prime (two divisors: 1 and 2).
- 3 is prime (two divisors: 1 and 3).
- 4 is not prime (three divisors: 1, 2, and 4).

What Are Prime Numbers?

Definition

A prime number is a number that has exactly two divisors.

Example

- 2 is prime (two divisors: 1 and 2).
- 3 is prime (two divisors: 1 and 3).
- 4 is not prime (three divisors: 1, 2, and 4).

What Are Prime Numbers?

Definition

A prime number is a number that has exactly two divisors.

Example

- 2 is prime (two divisors: 1 and 2).
- 3 is prime (two divisors: 1 and 3).
- 4 is not prime (three divisors: 1, 2, and 4).

There Is No Largest Prime Number

The proof uses *reductio ad absurdum*.

Theorem

There is no largest prime number.

There Is No Largest Prime Number

The proof uses *reductio ad absurdum*.

Theorem

There is no largest prime number.

The proof used *reductio ad absurdum*.

There Is No Largest Prime Number

The proof uses *reductio ad absurdum*.

Theorem

There is no largest prime number.

Proof.

1. Suppose p were the largest prime number.
2. Let q be the product of the first p numbers.
3. Then $q + 1$ is not divisible by any of them.
4. But $q + 1$ is greater than 1, thus divisible by some prime number not in the first p numbers. □

The proof used *reductio ad absurdum*.

What's Still To Do?

Answered Questions

How many primes are there?

Open Questions

Is every even number the sum of two primes?

What's Still To Do?

Answered Questions

How many primes are there?

Open Questions

Is every even number the sum of two primes?[1]

What's Still To Do?

Answered Questions

How many primes are there?

Open Questions

Is every even number the sum of two primes?[1]

An Algorithm For Finding Prime Numbers.

```
int main (void)
{
  std::vector<bool> is_prime (100, true);
  for (int i = 2; i < 100; i++)
    if (is_prime[i])
      {
        std::cout << i << " ";
        for (int j = i; j < 100; is_prime [j] = false, j+=i);
      }
return 0; }
```

Note the use of `std::`.

An Algorithm For Finding Prime Numbers.

```
int main (void)
{
  std::vector<bool> is_prime (100, true);
  for (int i = 2; i < 100; i++)
    if (is_prime[i])
      {
        std::cout << i << " ";
        for (int j = i; j < 100; is_prime [j] = false, j+=i);
      }
return 0; }
```

Note the use of `std::`.

An Algorithm For Finding Primes Numbers.

```
int main (void)
{
  std::vector<bool> is_prime (100, true);
  for (int i = 2; i < 100; i++)
 if (is_prime[i])
 {
 }
 std::cout << i << " ";
 for (int j = i; j < 100;
 is_prime [j] = false, j+=i);
  return 0;
}
```

An Algorithm For Finding Primes Numbers.

```
int main (void)
{
  std::vector<bool> is_prime (100, true);
  for (int i = 2; i < 100; i++)
 if (is_prime[i])
 {
 }
 std::cout << i << " ";
 for (int j = i; j < 100;
 is_prime [j] = false, j+=i);
  return 0;
}
```

An Algorithm For Finding Primes Numbers.

```
int main (void)
{
  std::vector<bool> is_prime (100, true);
  for (int i = 2; i < 100; i++)
 if (is_prime[i])
 {
 }
 std::cout << i << " ";
 for (int j = i; j < 100;
 is_prime [j] = false, j+=i);
  return 0;
}
```

An Algorithm For Finding Primes Numbers.

```
int main (void)
{
  std::vector<bool> is_prime (100, true);
  for (int i = 2; i < 100; i++)
 if (is_prime[i])
 {
 }
 std::cout << i << " ";
 for (int j = i; j < 100;
 is_prime [j] = false, j+=i);
  return 0;
}
```

Note the use of `std::`.

Make Titles Informative.

Make Titles Informative.

Make Titles Informative.

Summary

- The first main message of your talk in one or two lines.
- The second main message of your talk in one or two lines.
- Perhaps a third message, but not more than that.

- Outlook
  - Something you haven't solved.
  - Something else you haven't solved.

For Further Reading I

A. Author.
Handbook of Everything.
Some Press, 1990.

S. Someone.
On this and that.
Journal of This and That, 2(1):50–100, 2000.

[Goldbach, 1742] Christian Goldbach.
A problem we should try to solve before the ISPN ’43 deadline,
Letter to Leonhard Euler, 1742.