Functions
About the Course
The 61A Community
The 61A Community

57 teaching assistants (TAs), formally known at Berkeley as GSIs or UGSIs:
The 61A Community

57 teaching assistants (TAs), formally known at Berkeley as GSIs or UGSIs:
• Teach lab & discussion sections
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- Teach lab & discussion sections
- Hold drop-in office hours
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200+ academic interns help answer individual questions during lab
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2,000 fellow students make CS 61A unique
Parts of the Course
Parts of the Course

**Lecture:** Videos posted to cs61a.org before each live lecture
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**Lab section:** The most important part of this course (*next week*)
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*Everything is posted to cs61a.org*
Announcements
An Introduction to Computer Science
What is Computer Science?
What is Computer Science?

The study of
What is Computer Science?

The study of...

What problems can be solved using computation,
What is Computer Science?

The study of

What problems can be solved using computation,
How to solve those problems, and
What is Computer Science?

The study of

What problems can be solved using computation,
How to solve those problems, and
What techniques lead to effective solutions
What is Computer Science?

The study of

What problems can be solved using computation,
How to solve those problems, and
What techniques lead to effective solutions

Systems
What is Computer Science?

- What problems can be solved using computation,
- How to solve those problems, and
- What techniques lead to effective solutions

The study of

Systems

Artificial Intelligence
What is Computer Science?

The study of

- What problems can be solved using computation,
- How to solve those problems, and
- What techniques lead to effective solutions

Systems

Artificial Intelligence

Graphics
What is Computer Science?

What problems can be solved using computation, How to solve those problems, and What techniques lead to effective solutions

The study of

Systems
Artificial Intelligence
Graphics
Security
What is Computer Science?

The study of Computer Science includes:

- What problems can be solved using computation,
- How to solve those problems, and
- What techniques lead to effective solutions

Systems
Artificial Intelligence
Graphics
Security
Networking
Programming Languages
Theory
Scientific Computing

...
What is Computer Science?

The study of

What problems can be solved using computation,
How to solve those problems, and
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Systems
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Theory
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What is Computer Science?

The study of

What problems can be solved using computation,
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Artificial Intelligence

Decision Making

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- What problems can be solved using computation,
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The study of...

Systems

Artificial Intelligence

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Programming Languages

Theory

Scientific Computing

...
# What is Computer Science?

What problems can be solved using computation, 
How to solve those problems, and 
What techniques lead to effective solutions

<table>
<thead>
<tr>
<th>The study of</th>
<th>Systems</th>
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<tr>
<td>Artificial Intelligence</td>
<td>Decision Making</td>
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<tr>
<td>Graphics</td>
<td>Robotics</td>
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<td>Security</td>
<td>Natural Language Processing</td>
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<td>Theory</td>
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<td>Scientific Computing</td>
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</tbody>
</table>
What is Computer Science?

The study of...

What problems can be solved using computation,
How to solve those problems, and
What techniques lead to effective solutions

Systems
Artificial Intelligence
Graphics
Security
Networking
Programming Languages
Theory
Scientific Computing

...
What is Computer Science?

The study of What problems can be solved using computation,

How to solve those problems, and

What techniques lead to effective solutions

Systems

Artificial Intelligence Decision Making

Graphics Robotics

Security Natural Language Processing

Networking ...

Programming Languages ...

Theory

Scientific Computing
What is Computer Science?

The study of what problems can be solved using computation, how to solve those problems, and what techniques lead to effective solutions.

Systems
Artificial Intelligence
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Decision Making
Robotics
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Answering Questions

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Natural Language Processing

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Translation

Theory

Scientific Computing

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Systems

- Artificial Intelligence
- Graphics
- Security
- Networking
- Programming Languages
- Theory
- Scientific Computing

...
What is This Course About?
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A course about managing complexity
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A course about managing complexity

Mastering abstraction
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Programming paradigms
What is This Course About?

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An introduction to programming
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An introduction to programming

   Full understanding of Python fundamentals
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Different types of languages: Scheme & SQL
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How computers interpret programming languages

Different types of languages: Scheme & SQL

A challenging course that will demand a lot of you
Alternatives to CS 61A
CS 10: The Beauty and Joy of Computing
CS 10: The Beauty and Joy of Computing

Designed for students without prior experience
CS 10: The Beauty and Joy of Computing

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A programming environment created by Berkeley, now used in courses around the world and online
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More info: http://cs10.org/fa18/
Data Science 8: Foundations of Data Science

Fundamentals of computing, statistical inference, & machine learning applied to real-world data sets
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Course Policies
Course Policies
Learning
Learning
Community

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Learning

Community

Course Staff
Learning

Community

Course Staff

Details...

http://cs61a.org/articles/about.html
Collaboration
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**The limits of collaboration**
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**Build good habits now**
Expressions
Types of expressions
Types of expressions

An expression describes a computation and evaluates to a value
Types of expressions

An expression describes a computation and evaluates to a value

\[ 18 + 69 \]
Types of expressions

An expression describes a computation and evaluates to a value

\[
18 + 69 = \frac{6}{23}
\]
Types of expressions

An expression describes a computation and evaluates to a value

\[ 18 + 69 \]
\[ \frac{6}{23} \]
\[ \sqrt{3493161} \]
Types of expressions

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\[ 18 + 69 \]
\[ \frac{6}{23} \]
\[ \sin \pi \]
\[ \sqrt{3493161} \]
Types of expressions

An expression describes a computation and evaluates to a value

\[ 18 + 69 \quad \frac{6}{23} \quad \sin \pi \quad \sqrt{3493161} \quad | - 1869 | \]
Types of expressions

An expression describes a computation and evaluates to a value

\[ 18 + 69 \]
\[ \frac{6}{23} \]
\[ \sin \pi \]
\[ \sqrt{3493161} \]
\[ \sum_{i=1}^{100} i \]
\[ | - 1869| \]
Types of expressions

An expression describes a computation and evaluates to a value

\[
18 + 69 \quad \frac{6}{23} \quad \sin \pi \quad \sqrt{3493161} \quad \sum_{i=1}^{100} i \quad \left| -1869 \right| \quad \left(69\right) \quad \left(18\right)
\]
Types of expressions

An expression describes a computation and evaluates to a value

\[ f(x) \]

\[ 18 + 69 \]

\[ \frac{6}{23} \]

\[ \sin \pi \]

\[ \sqrt{3493161} \]

\[ \sum_{i=1}^{100} i \]

\[ | -1869| \]

\[ (69) \]

\[ (18) \]
Types of expressions

An expression describes a computation and evaluates to a value

\[ 18 + 69 \]
\[ \frac{6}{23} \]
\[ \sin \pi \]
\[ 2^{100} \]
\[ f(x) \]
\[ \sum_{i=1}^{100} i \]
\[ | - 1869| \]
\[ \sqrt{3493161} \]
\[ (69, 18) \]
Types of expressions

An expression describes a computation and evaluates to a value

\[ 18 + 69 \]
\[ \frac{6}{23} \]
\[ \sin \pi \]
\[ \log_2 1024 \]
\[ 2^{100} \]
\[ f(x) \]
\[ \sum_{i=1}^{100} i \]
\[ | - 1869| \]
\[ \sqrt{3493161} \]
\[ \left( \frac{69}{18} \right) \]
Types of expressions

An expression describes a computation and evaluates to a value

\[\begin{align*}
18 + 69 & \quad \frac{6}{23} & \quad \sin \pi & \quad \log_2 1024 \\
2^{100} & \quad f(x) & \quad \sqrt{3493161} & \quad 7 \mod 2 \\
7 \mod 2 & \quad \sum_{i=1}^{100} i & & \\
| - 1869| & & (69) & \begin{pmatrix} 18 \end{pmatrix}
\end{align*}\]
Types of expressions

An expression describes a computation and evaluates to a value

\[ 18 + 69 \]
\[ \frac{6}{23} \]
\[ \sin \pi \]
\[ \log_2 1024 \]
\[ 2^{100} \]
\[ f(x) \]
\[ 7 \mod 2 \]
\[ | - 1869| \]
\[ \sum_{i=1}^{100} i \]
\[ \sqrt{3493161} \]
\[ \lim_{x \to \infty} \frac{1}{x} \]
Types of expressions

An expression describes a computation and evaluates to a value

\[ 18 + 69 \quad \frac{6}{23} \quad \sin \pi \quad \log_2 1024 \]
\[ 2^{100} \quad \frac{100}{i=1} \quad \sqrt{3493161} \quad \lim_{x \to \infty} \frac{1}{x} \]
\[ 7 \mod 2 \quad \sum_{i=1}^{100} \quad | - 1869| \quad \binom{69}{18} \]
All expressions can use function call notation

(Demo)
Anatomy of a Call Expression
Anatomy of a Call Expression

\[
\text{add} \quad (\quad 2 \quad , \quad 3 \quad )
\]
Anatomy of a Call Expression

\[
\text{add} \ ( \ 2 \ , \ 3 \ )
\]
Anatomy of a Call Expression

\[
\text{add} \quad ( \quad 2 \quad , \quad 3 \quad )
\]

Operator
Anatomy of a Call Expression

\[
\text{add} \ ( \ 2 \ , \ 3 \ )
\]

Operator: add
Operand: 2, 3
Anatomy of a Call Expression

Operators and operands are also expressions
Anatomy of a Call Expression

Operators and operands are also expressions

So they evaluate to values
Anatomy of a Call Expression

Operators and operands are also expressions
So they evaluate to values

Evaluation procedure for call expressions:
Anatomy of a Call Expression

Operators and operands are also expressions
So they evaluate to values

Evaluation procedure for call expressions:

1. Evaluate the operator and then the operand subexpressions
Anatomy of a Call Expression

Evaluation procedure for call expressions:

1. Evaluate the operator and then the operand subexpressions
2. Apply the function that is the value of the operator to the arguments that are the values of the operands
Evaluating Nested Expressions

\[ \text{mul}(\text{add}(4, \text{mul}(4, 6)), \text{add}(3, 5)) \]
Evaluating Nested Expressions

\[ \text{mul}(\text{add}(4, \text{mul}(4, 6)), \text{add}(3, 5)) \]
Evaluating Nested Expressions

\[ \text{mul}(\text{add}(4, \text{mul}(4, 6)), \text{add}(3, 5)) \]
Evaluating Nested Expressions

mul(add(4, mul(4, 6)), add(3, 5))
mul
add(4, mul(4, 6))
Evaluating Nested Expressions

mul(add(4, mul(4, 6)), add(3, 5))
Evaluating Nested Expressions

\[
\text{mul(add(4, mul(4, 6)), add(3, 5))}
\]
Evaluating Nested Expressions

\[
\text{mul} (\text{add}(4, \text{mul}(4, 6)), \text{add}(3, 5))
\]
Evaluating Nested Expressions

\[ \text{mul}(\text{add}(4, \text{mul}(4, 6)), \text{add}(3, 5)) \]
Evaluating Nested Expressions

\[ \text{mul}(\text{add}(4, \text{mul}(4, 6)), \text{add}(3, 5)) \]
Evaluating Nested Expressions

\[ \text{mul}(\text{add}(4, \text{mul}(4, 6)), \text{add}(3, 5)) \]

- \text{mul} \ (4, \text{mul}(4, 6))
- \text{add} \ (4, \text{mul}(4, 6))
- 24
- 4
- \text{mul} \ (4, 6)
- \text{mul} \ (4, 6)
- \text{mul} \ (4, 6)
Evaluating Nested Expressions
Evaluating Nested Expressions

\[\text{mul}(\text{add}(4, \text{mul}(4, 6)), \text{add}(3, 5))\]
Evaluating Nested Expressions

```
mul(add(4, mul(4, 6)), add(3, 5))
```
Evaluating Nested Expressions

```
mul(add(4, mul(4, 6)), add(3, 5))
```

Diagram:
```
mul
  |
  |
add(4, mul(4, 6))
  |
  |
mul
  |
  |
4
  |
  |
mul(4, 6)
  |
  |
mul
  |
  |
4
  |
  |
6
```

```
add(3, 5)
```

```
add
  |
  |
3
  |
  |
5
```
Evaluating Nested Expressions

\[ \text{mul}(\text{add}(4, \text{mul}(4, 6)), \text{add}(3, 5)) \]
Evaluating Nested Expressions
Evaluating Nested Expressions

\[
mul(add(4, mul(4, 6)), add(3, 5))
\]
Evaluating Nested Expressions

```
mul(add(4, mul(4, 6)), add(3, 5))
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mul
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add
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```
Evaluating Nested Expressions

\[ \text{mul}(\text{add}(4, \text{mul}(4, 6)), \text{add}(3, 5)) \]

Diagram:
- \text{mul}(4, 6)
- \text{add}(3, 5)
- 224
Evaluating Nested Expressions

```
mul(add(4, mul(4, 6)), add(3, 5))
```

Expression tree
Evaluating Nested Expressions

Expression tree

Operand subexpression

mul(add(4, mul(4, 6)), add(3, 5))

mul

add(4, mul(4, 6))

add

mul(4, 6)

mul

4

24

mul

4

6

add

3

5

add

3

5
Evaluating Nested Expressions

Expression tree

Operand subexpression

Value of subexpression

224
mul(add(4, mul(4, 6)), add(3, 5))

28
mul
add(4, mul(4, 6))

4
add
mul(4, 6)

24
mul
4
6

8
add
add(3, 5)

3
5

Expression tree
Evaluating Nested Expressions

Expression tree

Operand subexpression
Value of subexpression
1st argument to mul
mul
add
mul
add
add
mul
Evaluating Nested Expressions

Expression tree

Operand subexpression

Value of subexpression

1st argument to mul

Value of the whole expression

mul(add(4, mul(4, 6)), add(3, 5))

mul

add(4, mul(4, 6))

add

mul(4, 6)

mul

Expression tree
Functions, Values, Objects, Interpreters, and Data

(Demo)