61A Lecture 30

Monday, April 13

Announcements

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  - Pass the tests for the designated questions
  - Run **python3 ok --submit**
  - Log on to http://ok.cs61a.org and create a group with your partner

Ray Tracing

A technique for displaying a 3D scene on a 2D screen by tracing a path through every pixel

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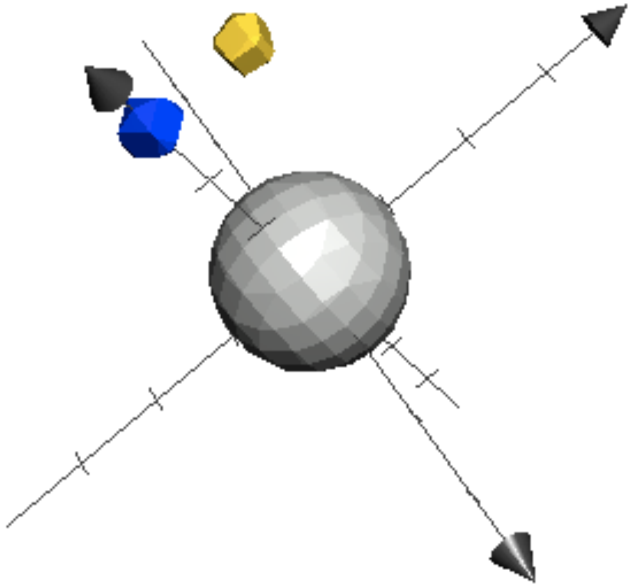

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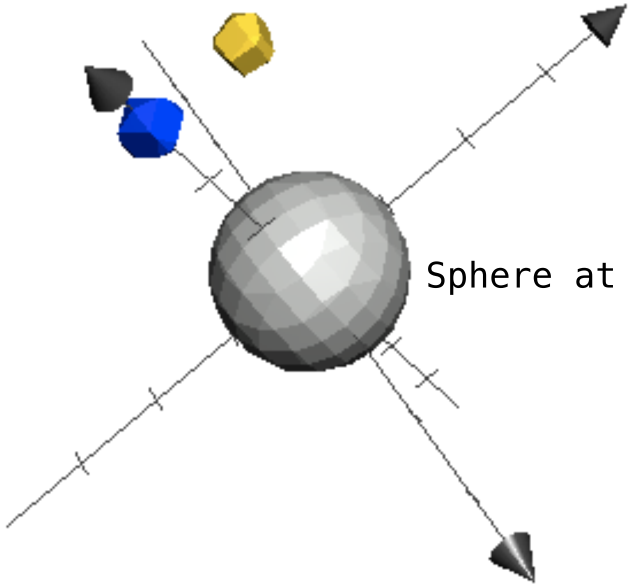

Sphere at origin

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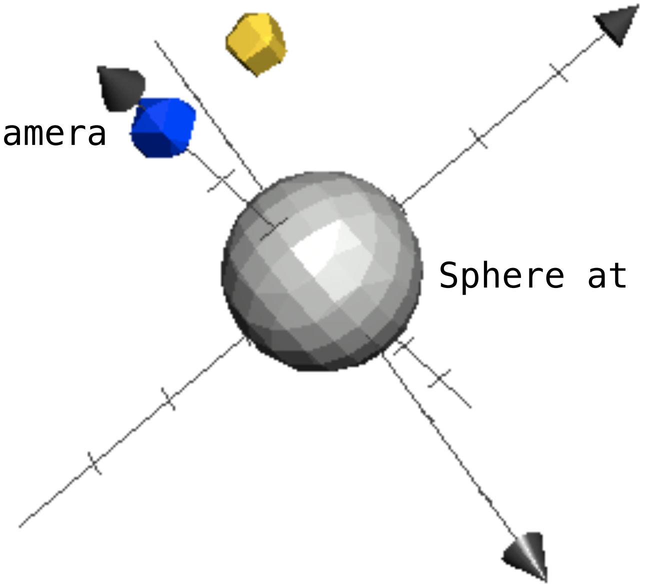

Camera

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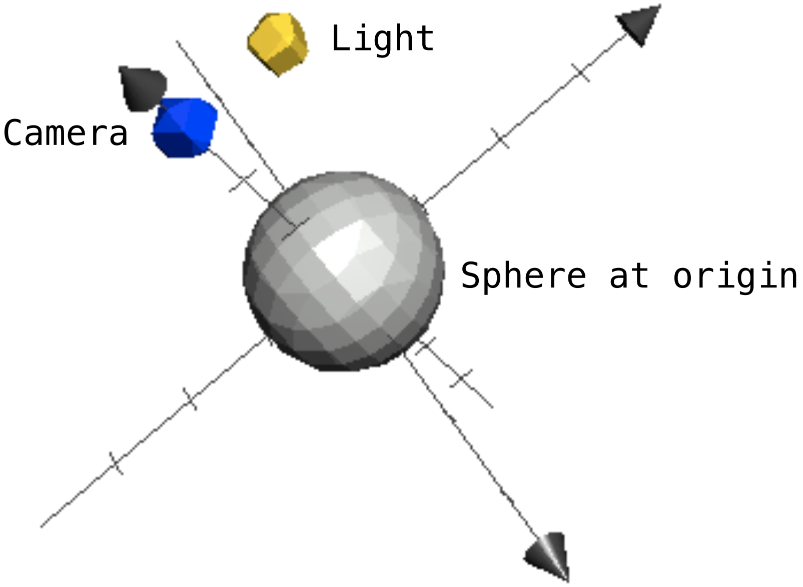

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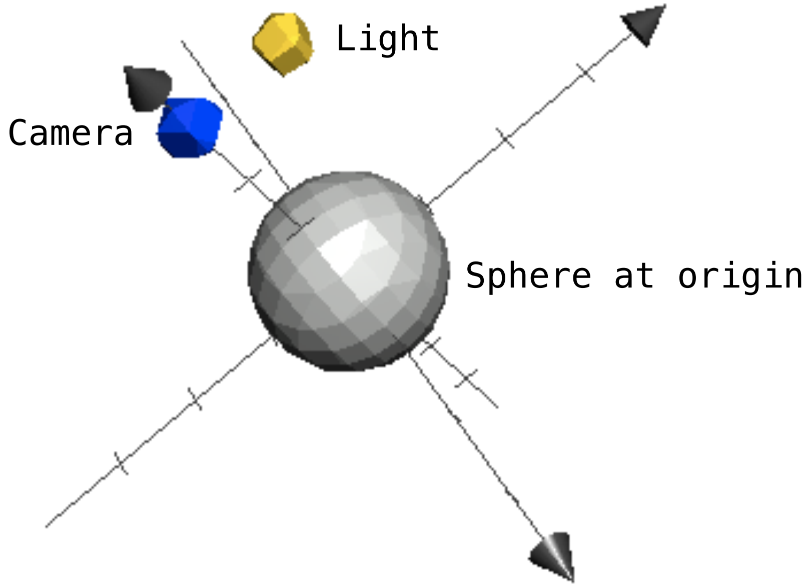

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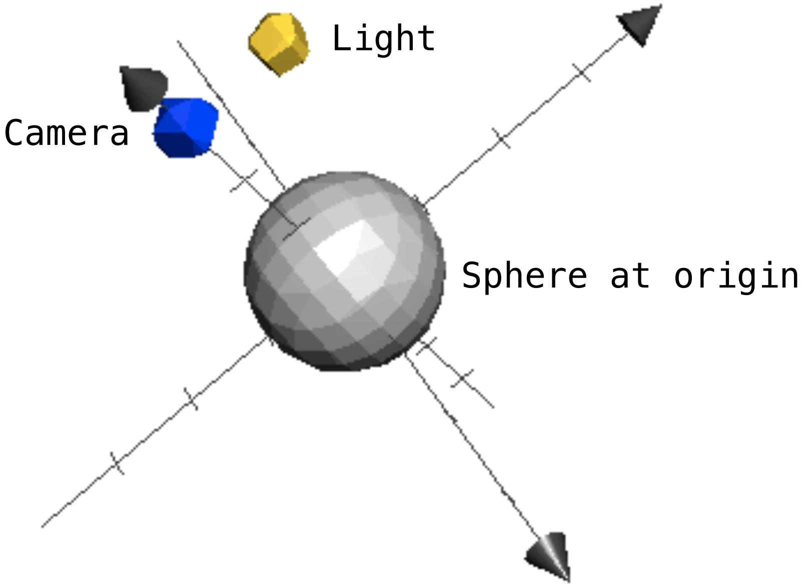

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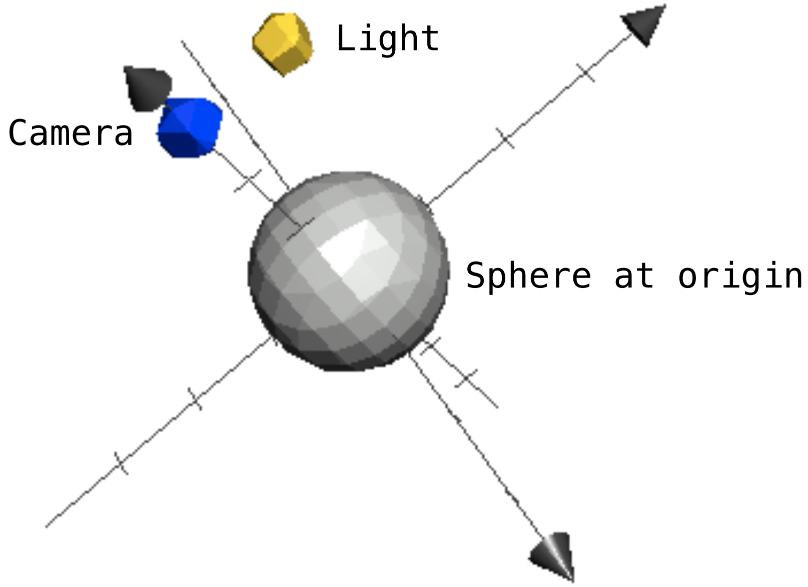

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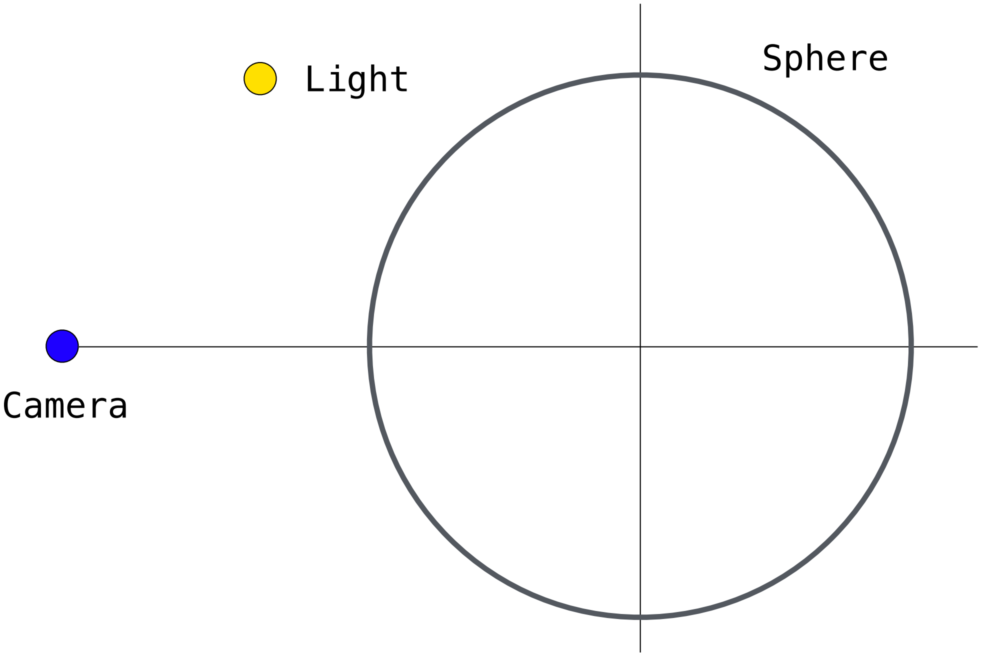

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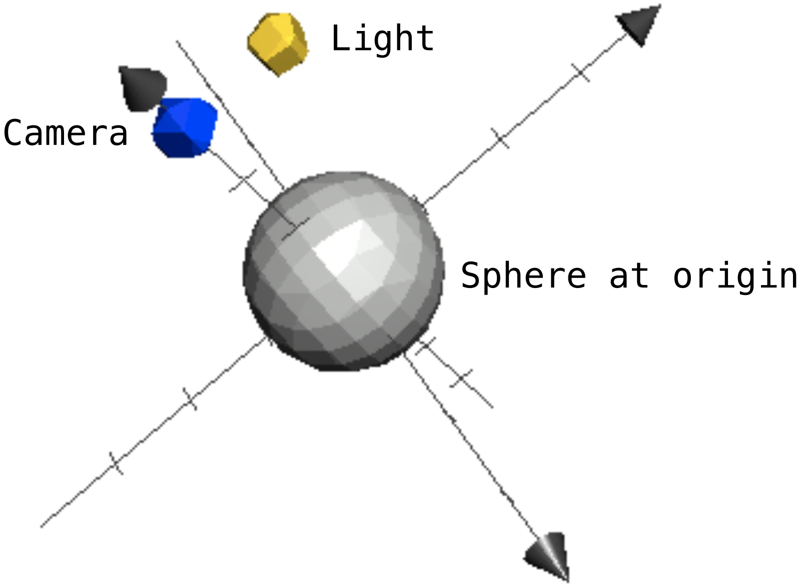

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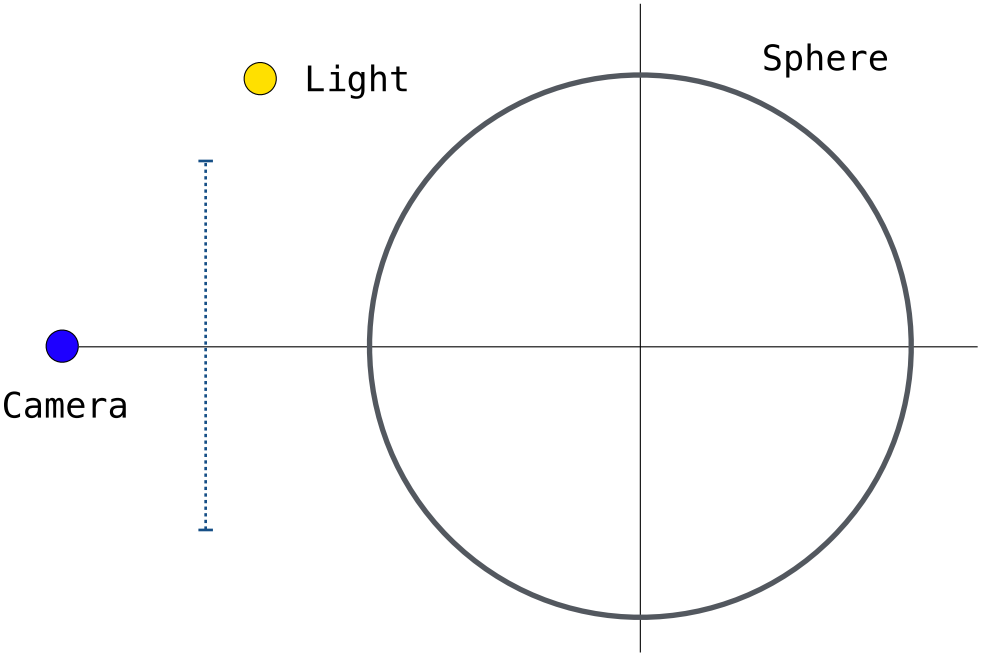

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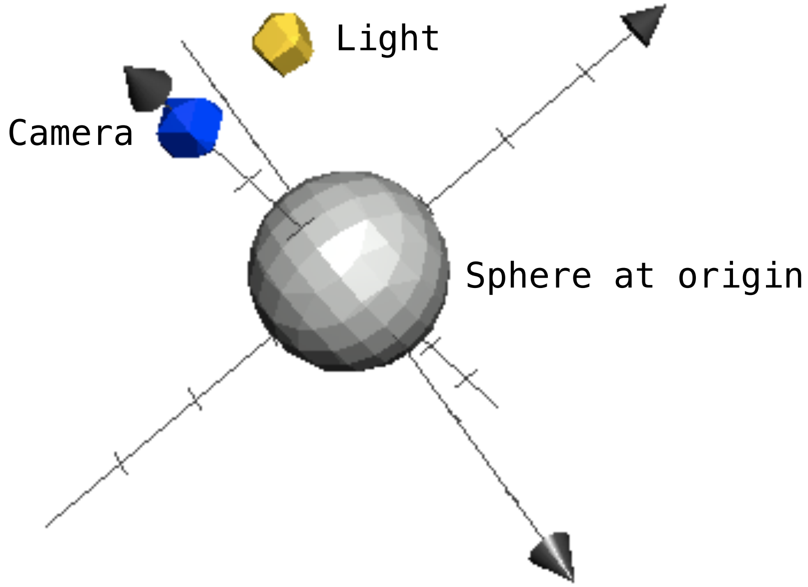

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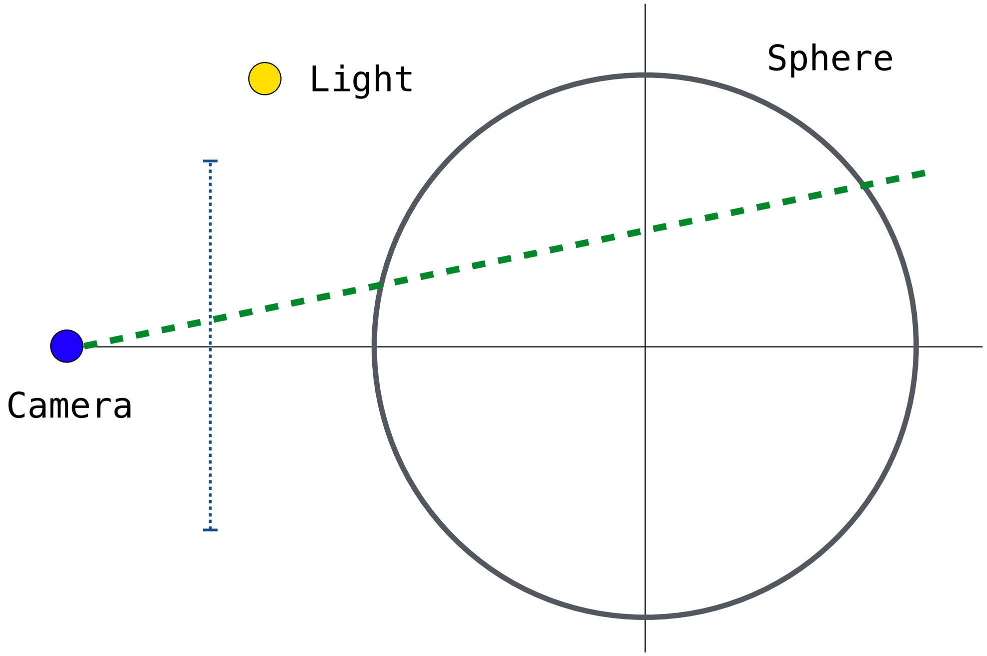

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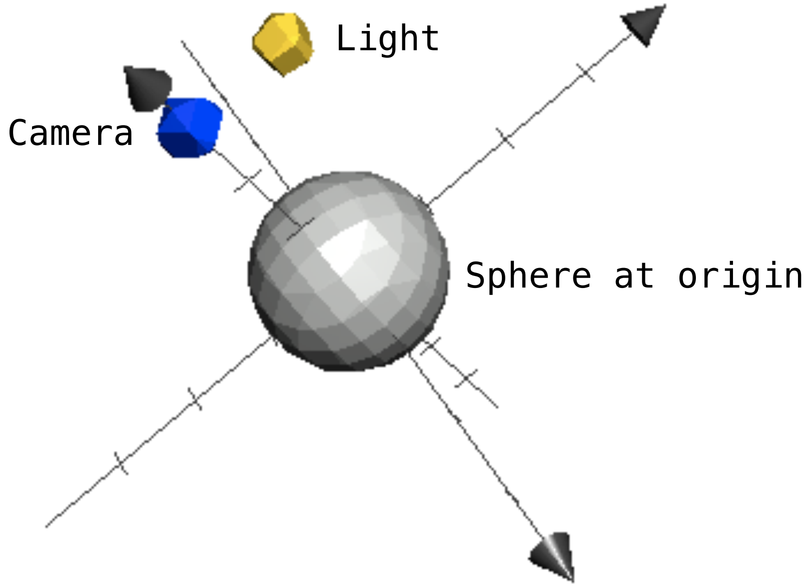

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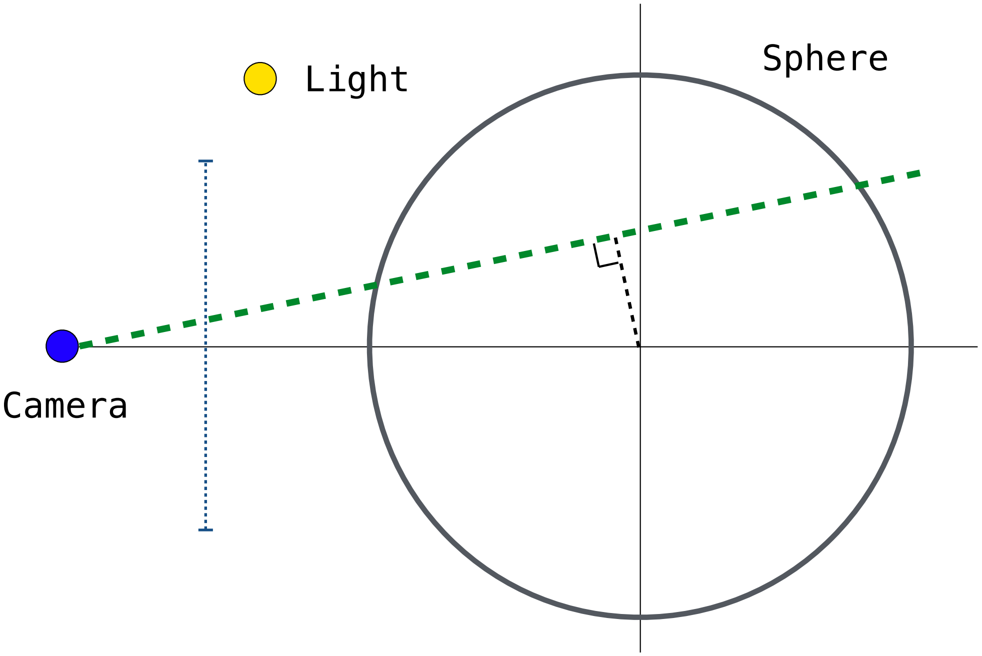

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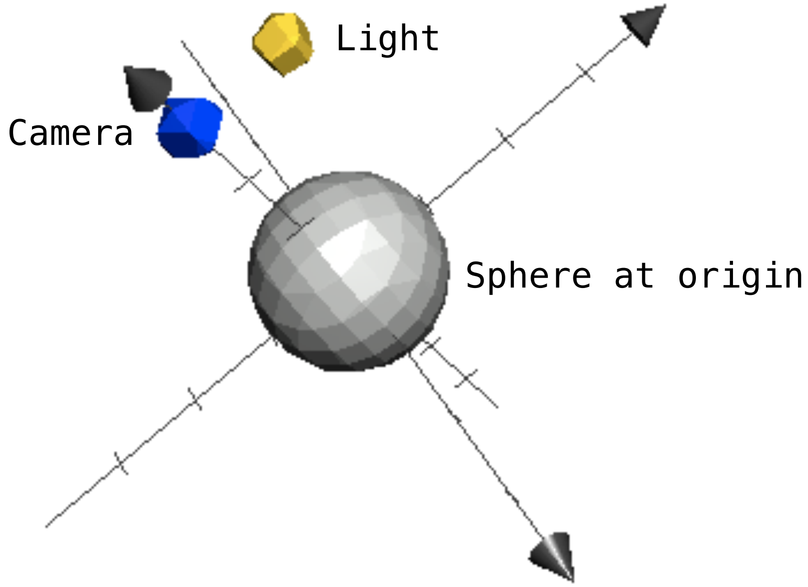

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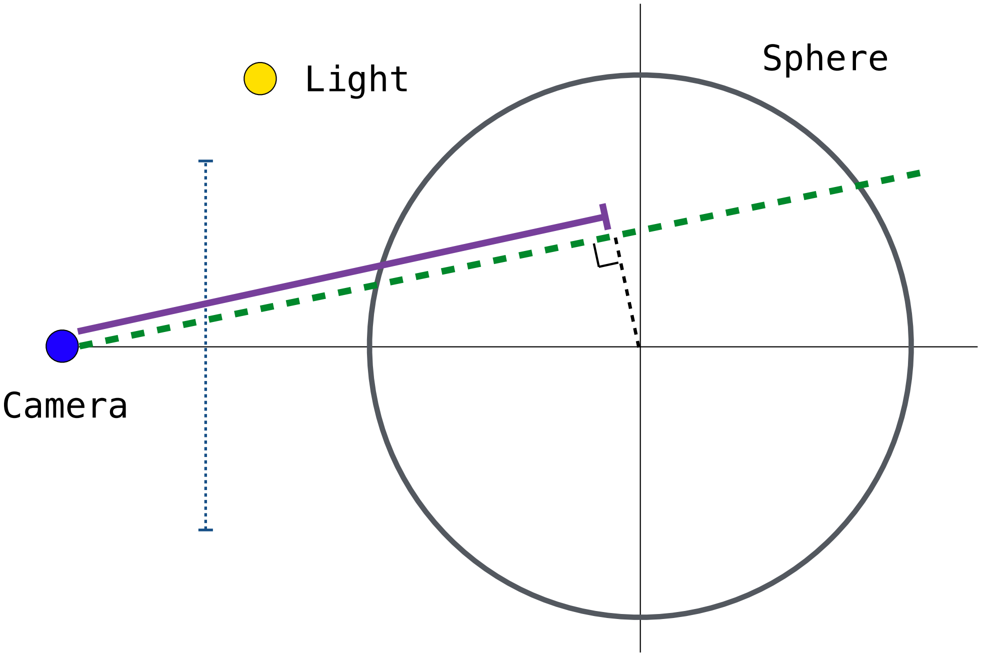

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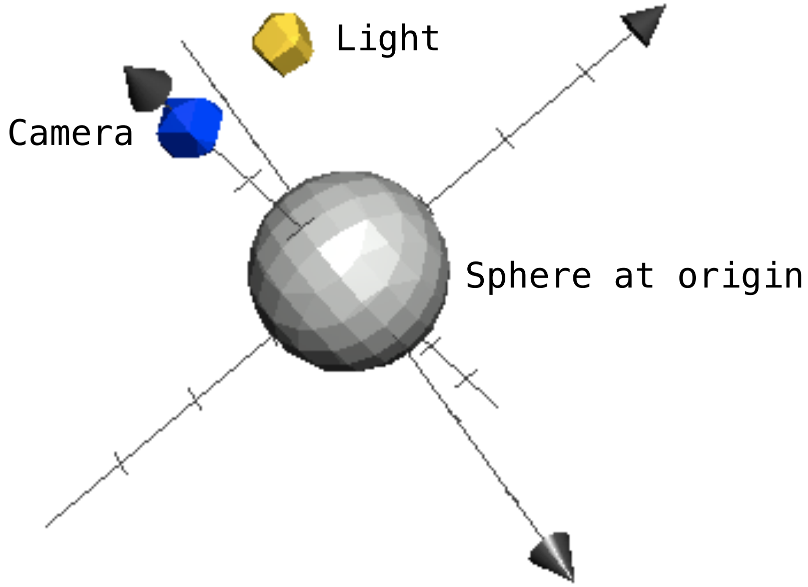

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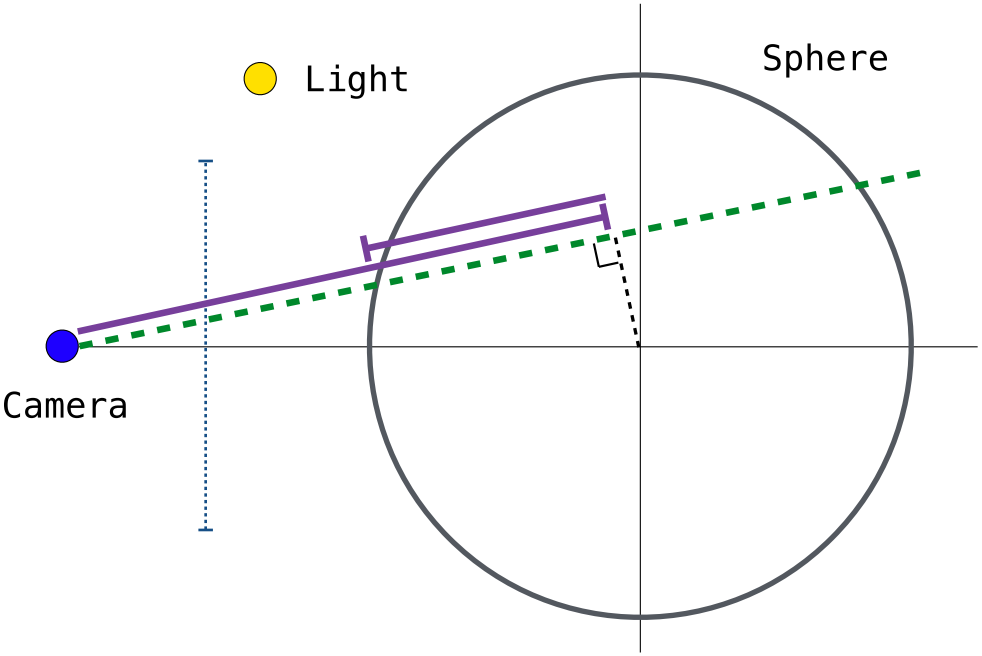

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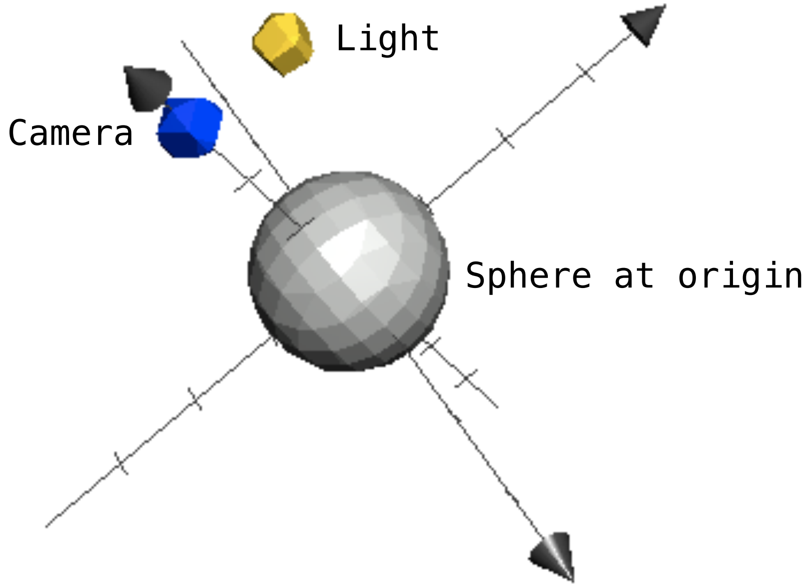

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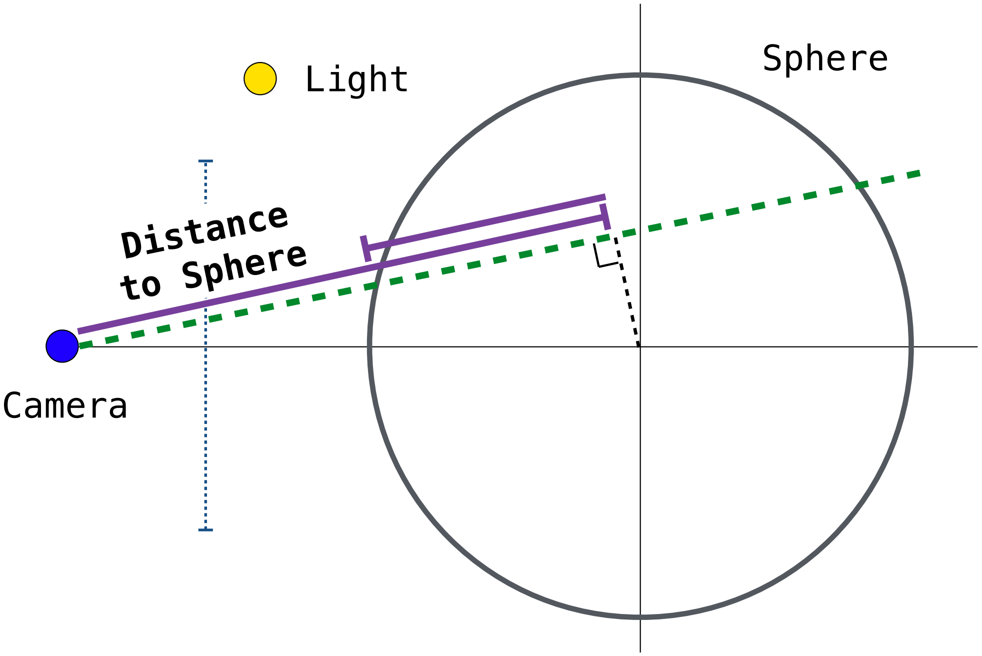

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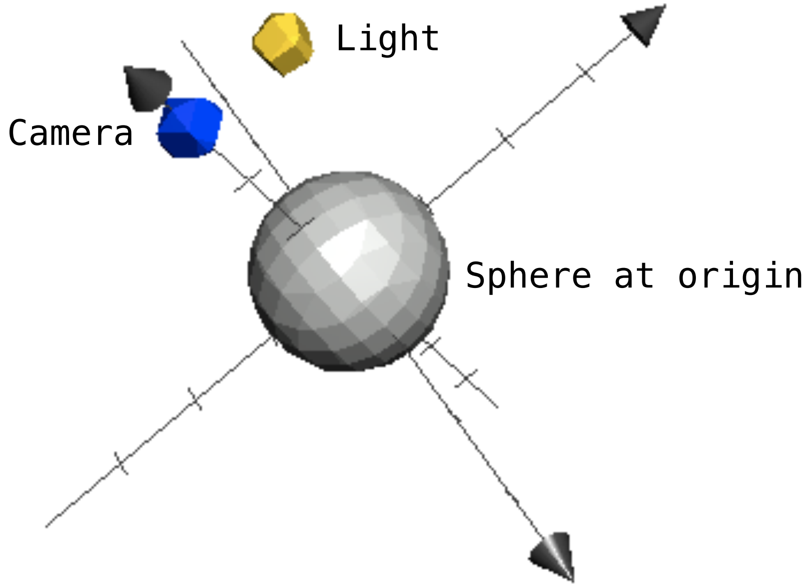

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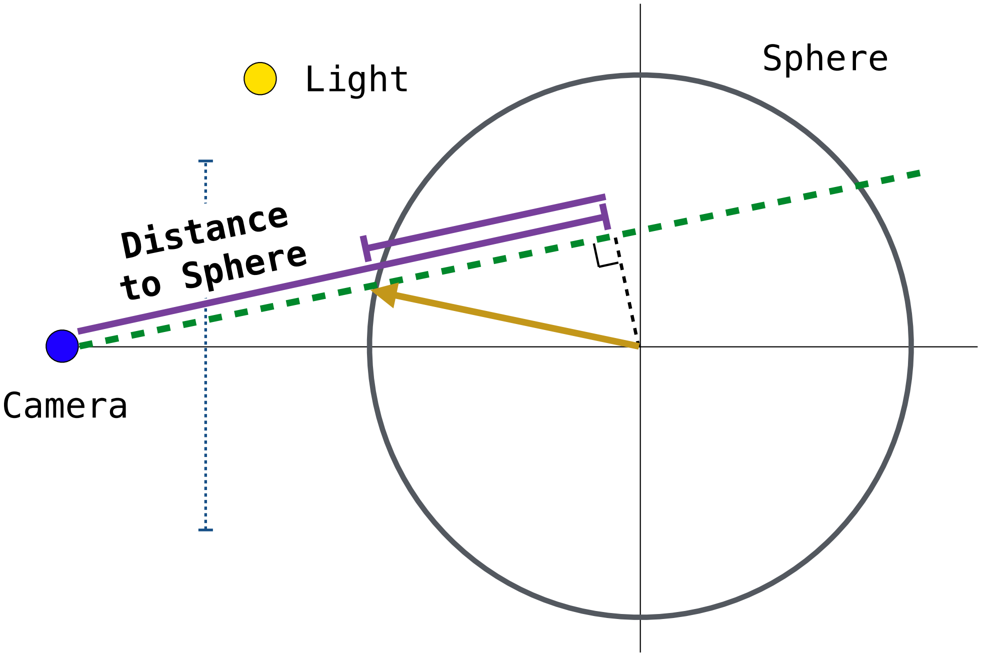

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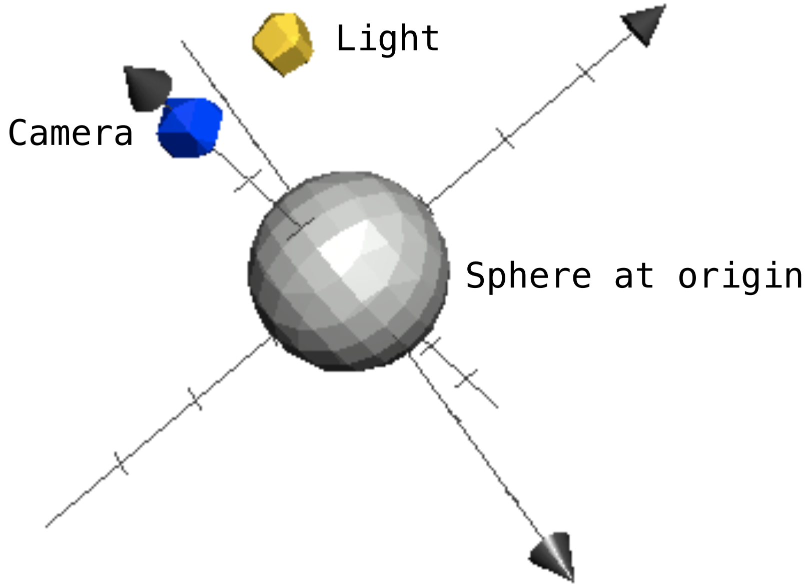

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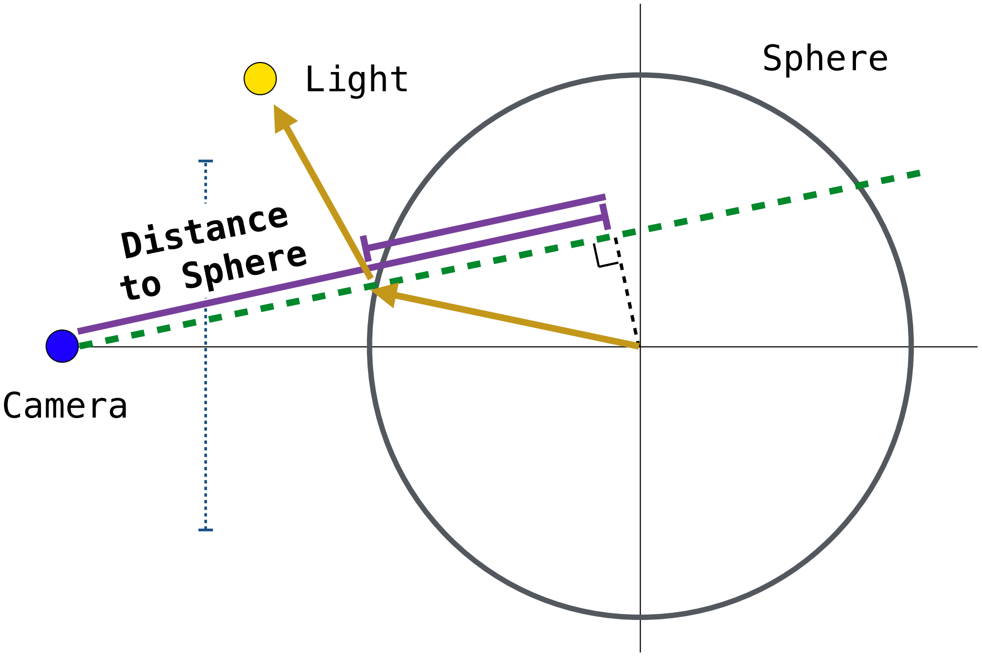

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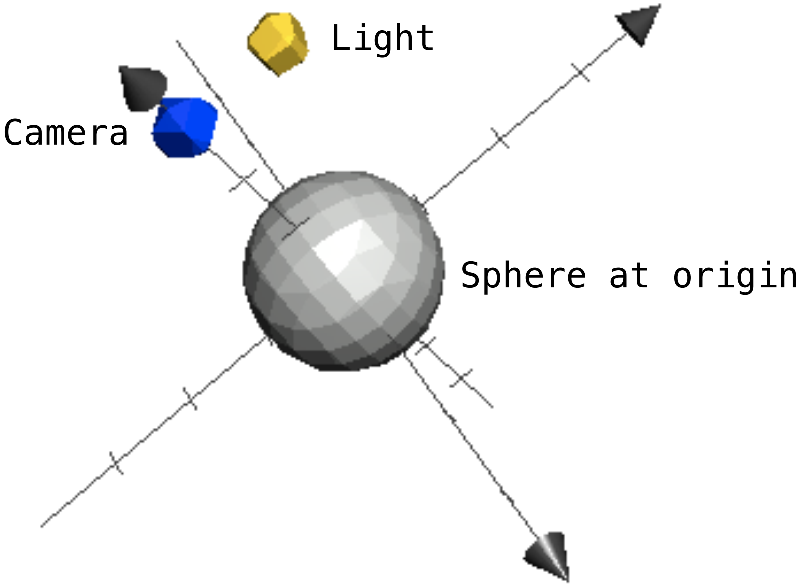

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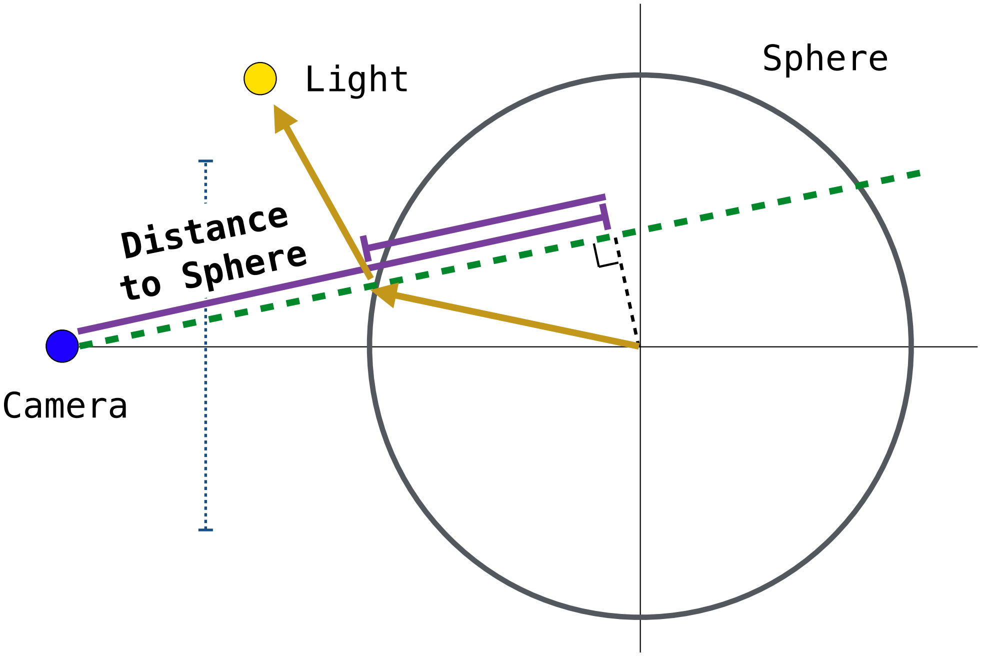

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Information Hiding

Attributes for Internal Use

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Starting a name with *two underscores* enforces restricted access from outside the class

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def fib_generator():
    """A generator function for Fibonacci numbers.

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There is no way to access values bound to "previous" and "current" externally

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Streams

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Link( __________________ , __________________ )
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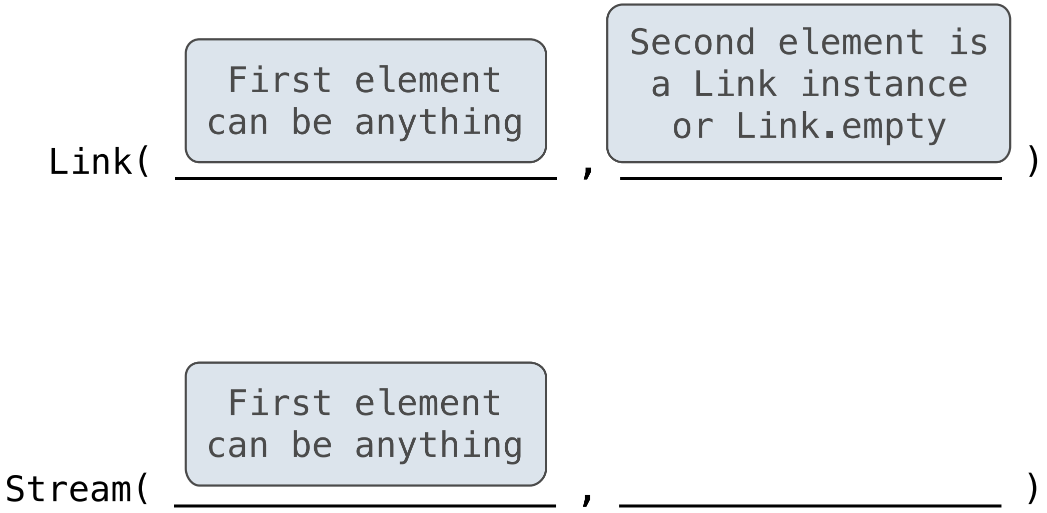

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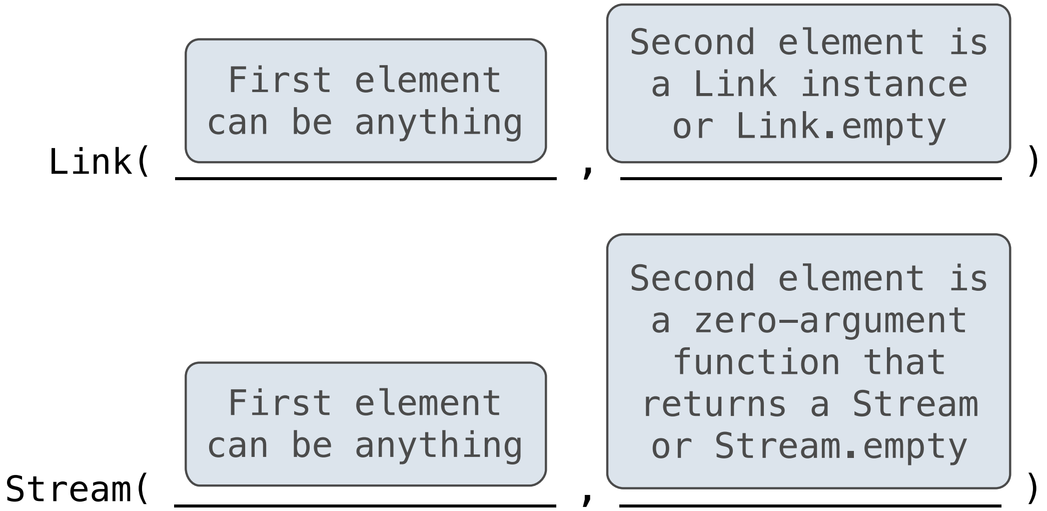

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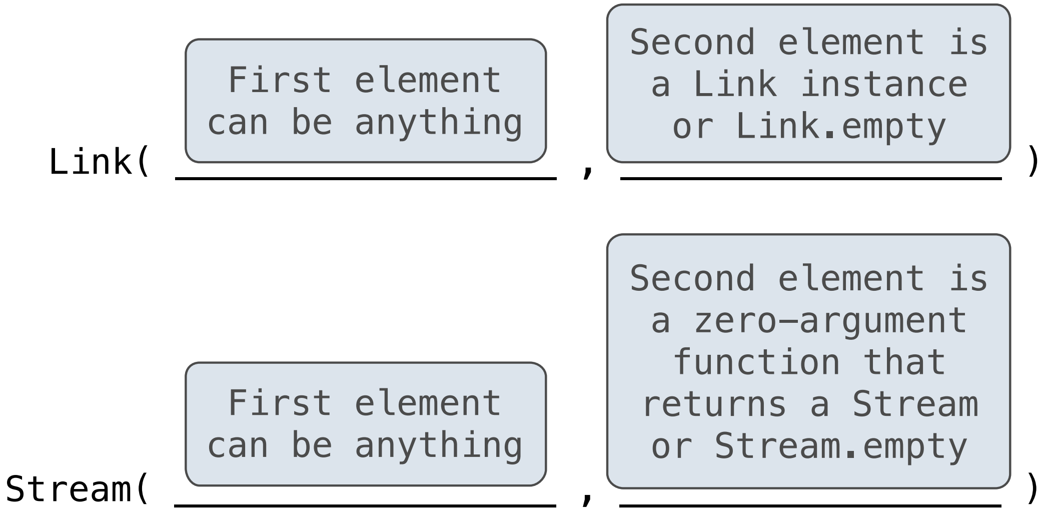

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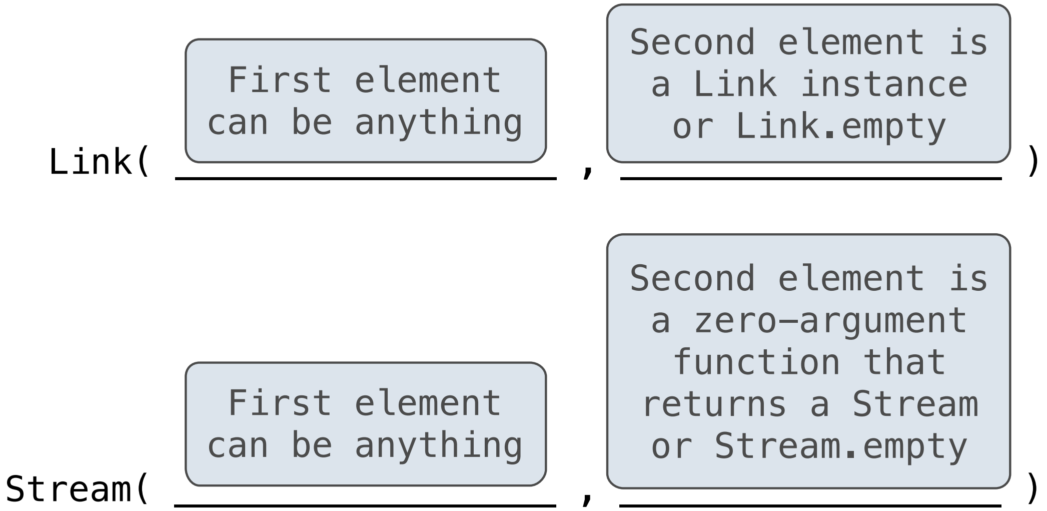

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(Demo)

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```
def integer_stream(first=1):
    """Return a stream of consecutive integers, starting with first.

    >>> s = integer_stream(3)
    >>> s.first
    3
    >>> s.rest.first
    4
    """
    def compute_rest():
        return integer_stream(first+1)
    return Stream(first, compute_rest)
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def f(x=[1]):
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def f(x=1):
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def f(x=[]):
    x.append(1)
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s.first	**s.rest.first**

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def f(x=[]):
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(Demo)

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        assert callable(compute_rest), 'compute_rest must be callable.'
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        self.first = first
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    @property
    def rest(self):
        """Return the rest of the stream, computing it if necessary."""
        if self._compute_rest is not None:
            self._rest = self._compute_rest()
            self._compute_rest = None
        return self._rest
```

Higher-Order Functions on Streams

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def map_stream(fn, s):
    """Map a function fn over the elements of a stream s."""
    if s is Stream.empty:
        return s
    def compute_rest():
        return map_stream(fn, s.rest)
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```
>>> s = integer_stream(3)
>>> s
Stream(3, <...>)
>>> m = map_stream(lambda x: x*x, s)
>>> first_k(m, 5)
[9, 16, 25, 36, 49]
```

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def filter_stream(fn, s):
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