Classes and Objects

Interfaces

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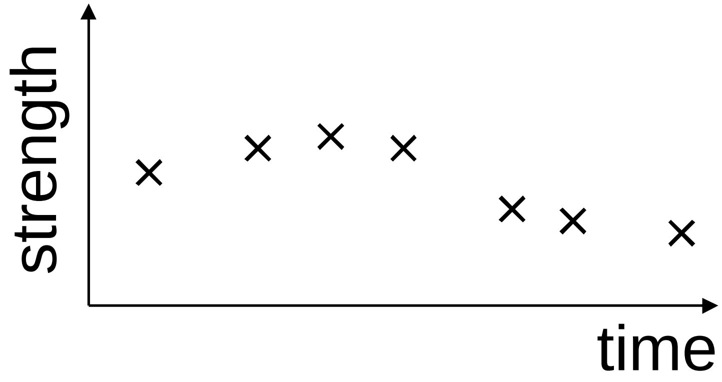
Interface: what something knows how to do

Implementation: how it does things

Programming to interfaces makes it (much) easier to test/change/replace parts of a program

Explain by example

Starting point: irregular time series signal



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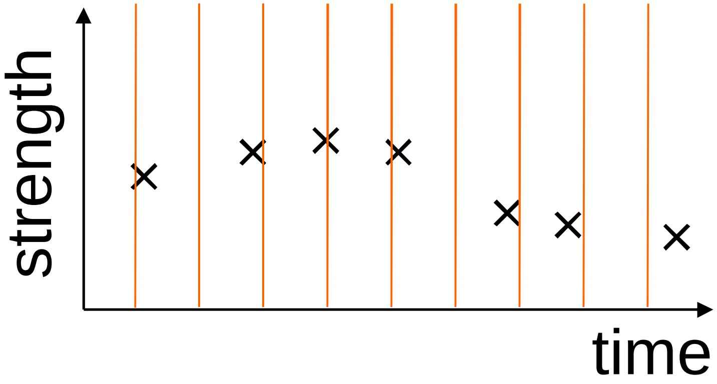
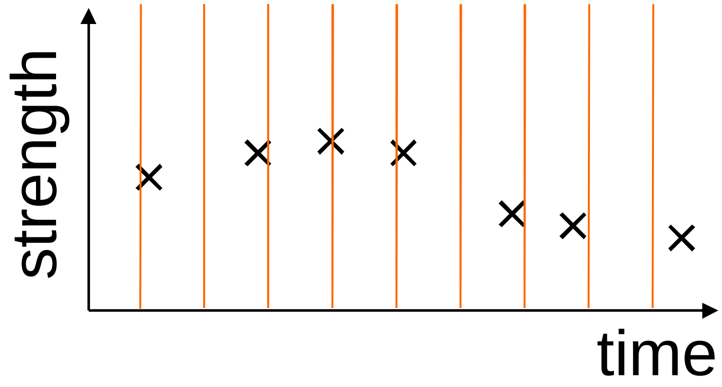
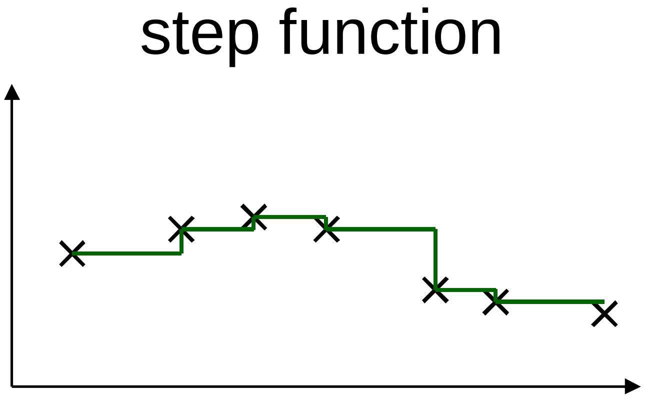


Hide irregularity by allowing sampling at any time

Starting point: irregular time series signal



Hide irregularity by allowing sampling at any time



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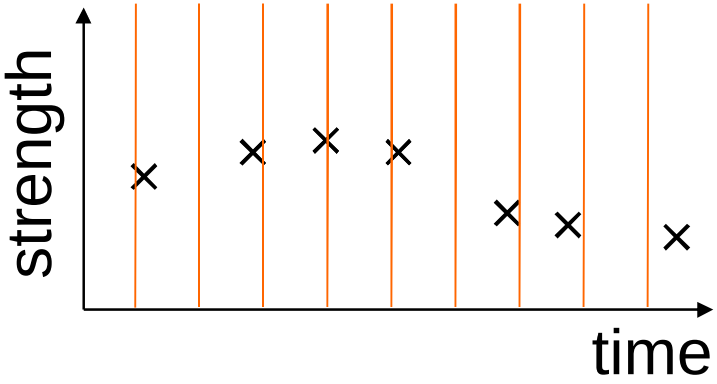
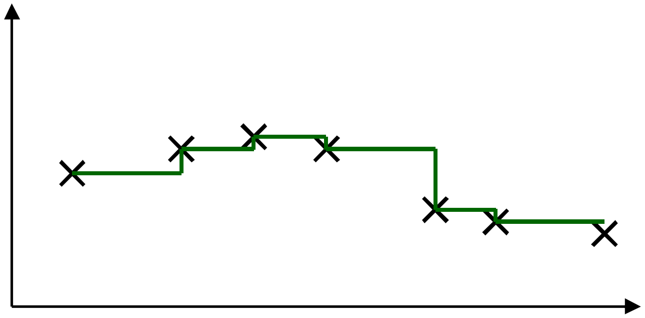
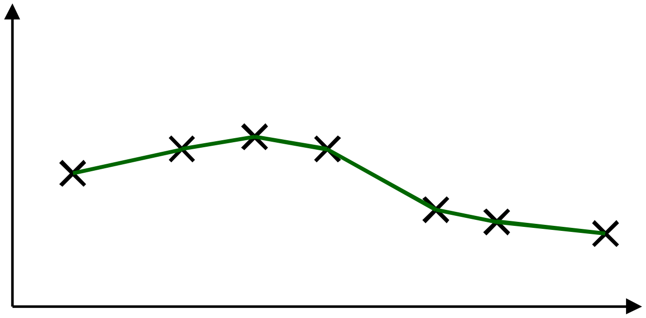


Hide irregularity by allowing sampling at any time

step function



linear interpolation



Define the interface first

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```
class SomeClassName(object):

  def __init__(self, values):
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    store values
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  def __init__(self, values):
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    store values

  def get(self, where):
    if where is out of bounds:
      raise exception
    else:
      return interpolated value
```

First implementation

```
class StepSignal(object):

  def __init__(self, values):
    self.values = values[:] # make a copy
```

First implementation

```
class StepSignal(object):
  ...
  def get(self, where):
    if where < self.values[0][0]:
      raise IndexError, '%f too low' % where
    for i in range(len(self.values)-1):
      x0, y0 = self.values[i]
      x1, y1 = self.values[i+1]
      if x0 <= where <= x1:
        return y0
    raise IndexError, '%f too high' % where
```

Test a few points

```
interp = StepSignal(((0., 0.), (1., 1.), (2.,
   2.)))
for x in (0.0, 0.5, 1.0, 1.75):
  print x, interp.get(x)
0.0 0.0
0.5 0.0
1.0 1.0
1.75 1.0
```

Test error handling too

```
for val in (-100.0, -0.0001, 2.0, 100.0):
  try:
    interp.get(val)
    assert False, 'Should not be here:', val
  except IndexError, e:
    print val, 'raised expected exception'
-100.0 raised expected exception
-0.0001 raised expected exception
2.0 raised expected exception
100.0 raised expected exception
```

Now create second implementation

```
class LinearSignal(object):
  ...
  def get(self, where):
    if where < self.values[0][0]:
      raise IndexError, '%f too low' % where
    for i in range(len(self.values)-1):
      x0, y0 = self.values[i]
      x1, y1 = self.values[i+1]
      if x0 <= where <= x1:
        return y0 + (y1-y0) * (where-x0) / 
   (x1-x0)
    raise IndexError, '%f too high' % where
```

Now create second implementation

```
class LinearSignal(object):
  ...
  def get(self, where):
    if where < self.values[0][0]:
      raise IndexError, '%f too low' % where
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      if x0 <= where <= x1:
        return y0 + (y1-y0) * (where-x0) /
   (x1-x0)
    raise IndexError, '%f too high' % where
```

Test it as well

```
interp = LinearSignal(((0., 0.), (1., 1.),
   (2., 2.)))
for x in (0.0, 0.5, 1.0, 1.75):
  print x, interp.get(x)
0.0 0.0
0.5 0.5
1.0 1.0
1.75 1.75
```

Test it as well

```
interp = LinearSignal(((0., 0.), (1., 1.),
   (2., 2.)))
for x in (0.0, 0.5, 1.0, 1.75):
  print x, interp.get(x)
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   (2., 2.)))
for x in (0.0, 0.5, 1.0, 1.75):
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```

Error handling still works

And now the payoff

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```
def average(signal, x0, x1, num_samples):
  width = (x1 - x0) / num_samples
  total = 0.0
  for i in range(num_samples):
    x = x0 + i * width
    total += signal.get(x)
  return total / num_samples
```

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Can use an object of either class for signal

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    x = x0 + i * width
    total += signal.get(x)
  return total / num_samples
```

Can use an object of either class for signal

Or an object of a class that doesn't exist yet

For exampleé

```
class Sinusoid(object):

  def __init__(self, amplitude, frequency):
    self.amp = amplitude
    self.freq = frequency

  def get(self, x):
    return self.amp * math.sin(x * self.freq)
```

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Clear interfaces make code more extensible

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    self.amp = amplitude
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  def get(self, x):
    return self.amp * math.sin(x * self.freq)
```

Clear interfaces make code more extensible

Only care about actual class when constructing

software carpentry

created by

Greg Wilson

January 2011