Lazy Evaluation

Lazy evaluation (called **short-circuit evaluation** in compiled languages) is a strategy some programming languages use to save work for the last minute or avoid unnecessary work altogether. For example, suppose we had a conditional like this:

```
C# (beta)
if (itIsFriday && itIsRaining)
{
    Console.WriteLine("board games at my place!");
}
```

Suppose `itIsFriday` was false. Because C# short-circuits evaluation, it wouldn't bother checking the value of `itIsRaining`—it knows that either way the result of our `&&` will be false, so we won't print the invitation to board game night.

We can use this to our advantage. For example, suppose we have a check like this:

```
C# (beta)
if (friends["Becky"].IsFreeThisFriday())
{
    InviteToBoardGameNight(friends["Becky"]);
}
```

What happens if 'Becky' isn't in our `friends` dictionary? In C#, we'll get a `KeyNotFoundException` (Python would similarly raise a `KeyError`, but Ruby and JavaScript would just give us a null object).

Instead, we could first confirm that 'Becky' and I are still on good terms:

```
C# (beta)
if (friends.ContainsKey("Becky") && friends["Becky"].IsFreeThisFriday())
{
    InviteToBoardGameNight(friends["Becky"]);
}
```

This way, if 'Becky' *isn't* in `friends`, C# will skip the second check about Becky being free and avoid throwing the `KeyNotFoundException`!

> This is all hypothetical, of course. It's not like things with Becky are weird or anything. We're totally cool. She's still in my friends dictionary for sure and I hope I'm still in hers and Becky if you're reading this I just want you to know you're still in my friends dictionary.

Python's **generators** are also an example of lazy evaluation. For example, the function `range()` in Python generates a list of numbers in a specific range:

```
Python
print range(1, 11)
# prints [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

# (the first argument to range()
# is inclusive, and the second is exclusive)
```

This is commonly used for looping. For example, if we wanted to count to `some_high_number`, we could do this:

```
Python
for i in range(1, some_high_number + 1):
    print "I've eaten " + i + " cakes"
```

But this will generate a list in memory whose size is order of `some_high_number`! That could be a lot of space.

So instead, we could use a generator. It behaves like a list in that we can loop through it, but instead of building up all of its contents at once, it simply generates the *next* element right when it's needed (lazily)!

There's a generator version of `range()` in Python: `xrange()`:

```python
# much more memory efficient!
for i in xrange(1, some_high_number + 1):
    print "I've eaten " + i + " cakes"
```

In Python 3 they went ahead and made `range()` a generator, so there is no `xrange()`.

We can also take a **lazy approach** in system design. For example, suppose we had a class for tracking temperatures:

```csharp
class TempTracker
{
    private List<int> _recordedTemps = new List<int>();

    public void Record(int temp)
    {
        _recordedTemps.Add(temp);
    }
}
```

Suppose we wanted to add a feature for getting the the highest temperature we've seen so far. We could "eagerly" keep the max up to date whenever we insert a new temperature:

```
C# (beta)
public class TempTrackerEager
{
    private List<int> _recordedTemps = new List<int>();
    private int _maxTemp = int.MinValue;

    public void Record(int temp)
    {
        _recordedTemps.Add(temp);
        if (temp > _maxTemp)
        {
            _maxTemp = temp;
        }
    }

    public int GetMax()
    {
        return _maxTemp;
    }
}
```

Or we could lazily (or "just in time") calculate the max whenever it's requested:

```
C# (beta)
public class TempTrackerLazy
{
    private List<int> _recordedTemps = new List<int>();

    public void Record(int temp)
    {
        _recordedTemps.Add(temp);
    }

    public int GetMax()
    {
        return _recordedTemps.Max();
    }
}
```

The best choice depends on how often you expect to run `GetMax()`!

> Becky, I haven't hosted another board game night since the incident. I know we both said things we didn't really mean and anyway Becky just if you're reading this please know that I've been cake free for 3 whole days now and it's hard but I'm doing it for you PLEASE Becky. Please.

What's next?

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