```java
record Some<T>(T get) implements Optional<T>{
  public T orElseGet(Supplier<T> unused){ return get; }
  public Optional<T> or(Supplier<Optional<T>> s){ return this; }
  public <U> Optional<U> map(Function<T, U> m){
    return Optional.ofNullable(m.apply(get));
  }
  public <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Objects.requireNonNull(m.apply(get));
  }
}

enum Empty implements Optional<Object>{ Instance; }
```

Pupon’s full solution 1/2

```java
public sealed interface Optional<T>
    extends Serializable permits Empty, Some<T>{
  @SuppressWarnings("unchecked")
  static <E> Optional<E> empty(){ return (Optional<E>)Empty.Instance; }
  static <T> Optional<T> of(T value){
    return new Some<T>(Objects.requireNonNull(value));
  }
  static <T> Optional<T> ofNullable(T value){
    return value == null ? empty() : new Some<T>(value);
  }
  default T orElseGet(Supplier<T> s){ return s.get(); }
  default Optional<T> or(Supplier<Optional<T>> s){
    return Objects.requireNonNull(s.get());
  }
  default <U> Optional<U> map(Function<T, U> m){ return Optional.empty(); }
  default Optional<T> filter(Predicate<T> p){
    return map(e->p.test(e) ? e : null);
  }
  default <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Optional.empty();
  }
}
```

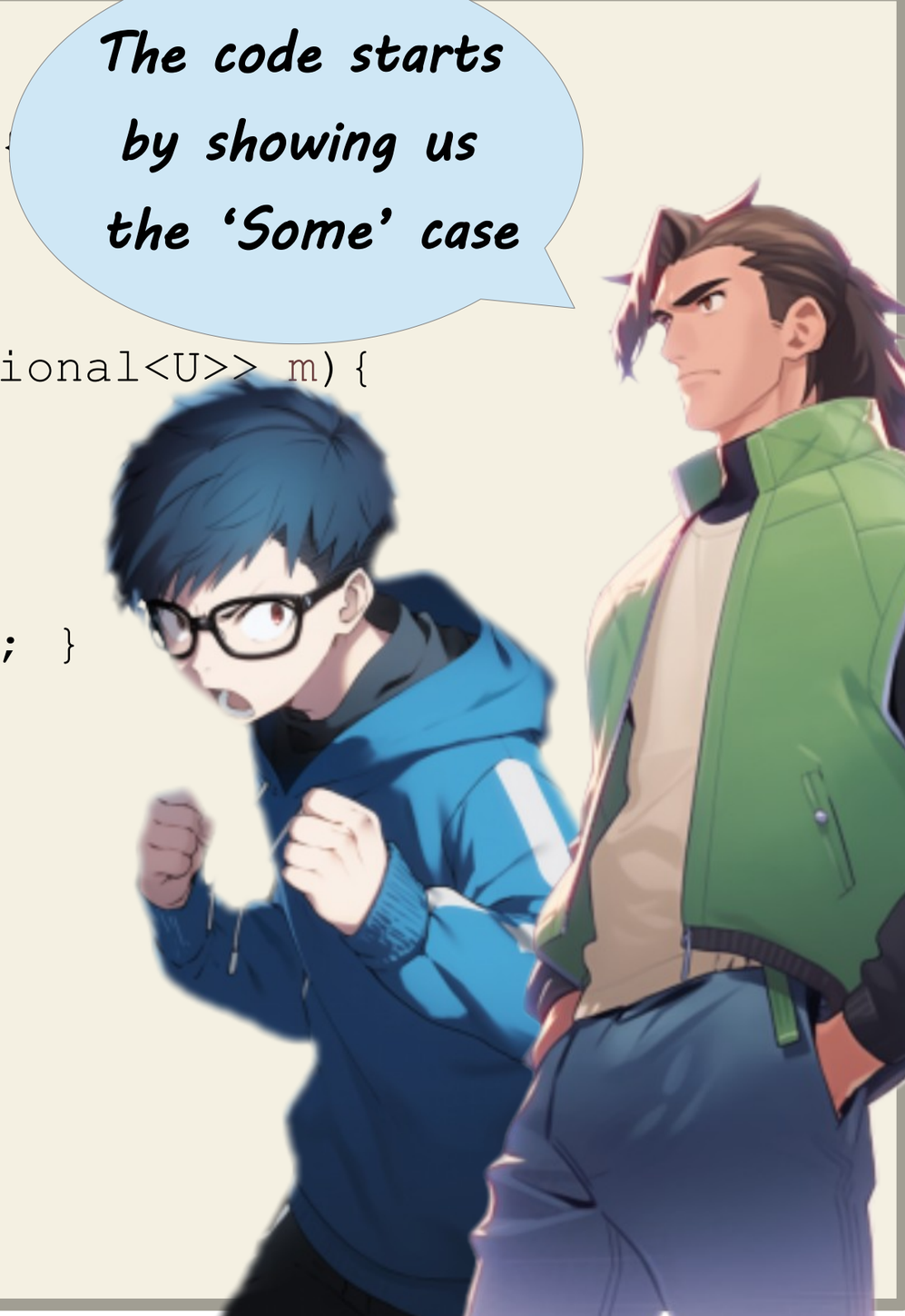
Pupon’s full solution 2/2

```java
record Some<T>(T get) implements Optional<T>{
  public T orElseGet(Supplier<T> unused){ return get; }
  public Optional<T> or(Supplier<Optional<T>> s){ return this; }
  public <U> Optional<U> map(Function<T, U> m){
    return Optional.ofNullable(m.apply(get));
  }
  public <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Objects.requireNonNull(m.apply(get));
  }
}

enum Empty implements Optional<Object>{ Instance; }
```

```
record Some<T>(T get) implements Optional<T>{
  public T orElseGet(Supplier<T> unused){ return
  public Optional<T> or(Supplier<Optional<T>> s)
  public <U> Optional<U> map(Function<T, U> m){
    return Optional.ofNullable(m.apply(get));
  }
  public <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Objects.requireNonNull(m.apply(get));
  }
}

enum Empty implements Optional<Object>{ Instance; }
```



```
record Some<T>(T get) implements Optional<T>{
  public T orElseGet(Supplier<T> unused){ return
  public Optional<T> or(Supplier<Optional<T>> s)
  public <U> Optional<U> map(Function<T, U> m){
    return Optional.ofNullable(m.apply(get));
  }
  public <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Objects.requireNonNull(m.apply(get));
  }
}

enum Empty implements Optional<Object>{ Instance; }
```

The code starts by showing us the 'Some' case

This case looks pretty much identical to what I wrote

```
record Some<T>(T get) implements Optional<T>{
  public T orElseGet(Supplier<T> unused){ return
  public Optional<T> or(Supplier<Optional<T>> s)
  public <U> Optional<U> map(Function<T, U> m){
    return Optional.ofNullable(m.apply(get));
  }
  public <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Objects.requireNonNull(m.apply(get));
  }
}

enum Empty implements Optional<Object>{ Instance; }
```

The code starts by showing us the 'Some' case

This case looks pretty much identical to what I wrote

But somehow, 'filter' is missing!

```java
record Some<T>(T get) implements Optional<T>{
  public T orElseGet(Supplier<T> unused){ return get; }
  public Optional<T> or(Supplier<Optional<T>> s){ return this; }
  public <U> Optional<U> map(Function<T, U> m){
    return Optional.ofNullable(m.apply(get));
  }
  public <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Objects.requireNonNull(m.apply(get));
  }
}

enum Empty implements Optional<Object>{ Instance; }
```

```java
record Some<T>(T get) implements Optional<T>{
  public T orElseGet(Supplier<T> unused){ return get; }
  public Optional<T> or(Supplier<Optional<T>> s){ return this; }
  public <U> Optional<U> map(Function<T, U> m){
    return Optional.ofNullable(m.apply(get));
  }
  public <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Objects.requireNonNull(m.apply(get));
  }
}

enum Empty implements Optional<Object>{ Instance; }
```

```java
record Some<T>(T get) implements Optional<T>{
  public T orElseGet(Supplier<T> unused){ return get; }
  public Optional<T> or(Supplier<Optional<T>> s){ return this; }
  public <U> Optional<U> map(Function<T, U> m){
    return Optional.ofNullable(m.apply(get));
  }
  public <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Objects.requireNonNull(m.apply(get));
  }
}

enum Empty implements Optional<Object>{ Instance; }
```

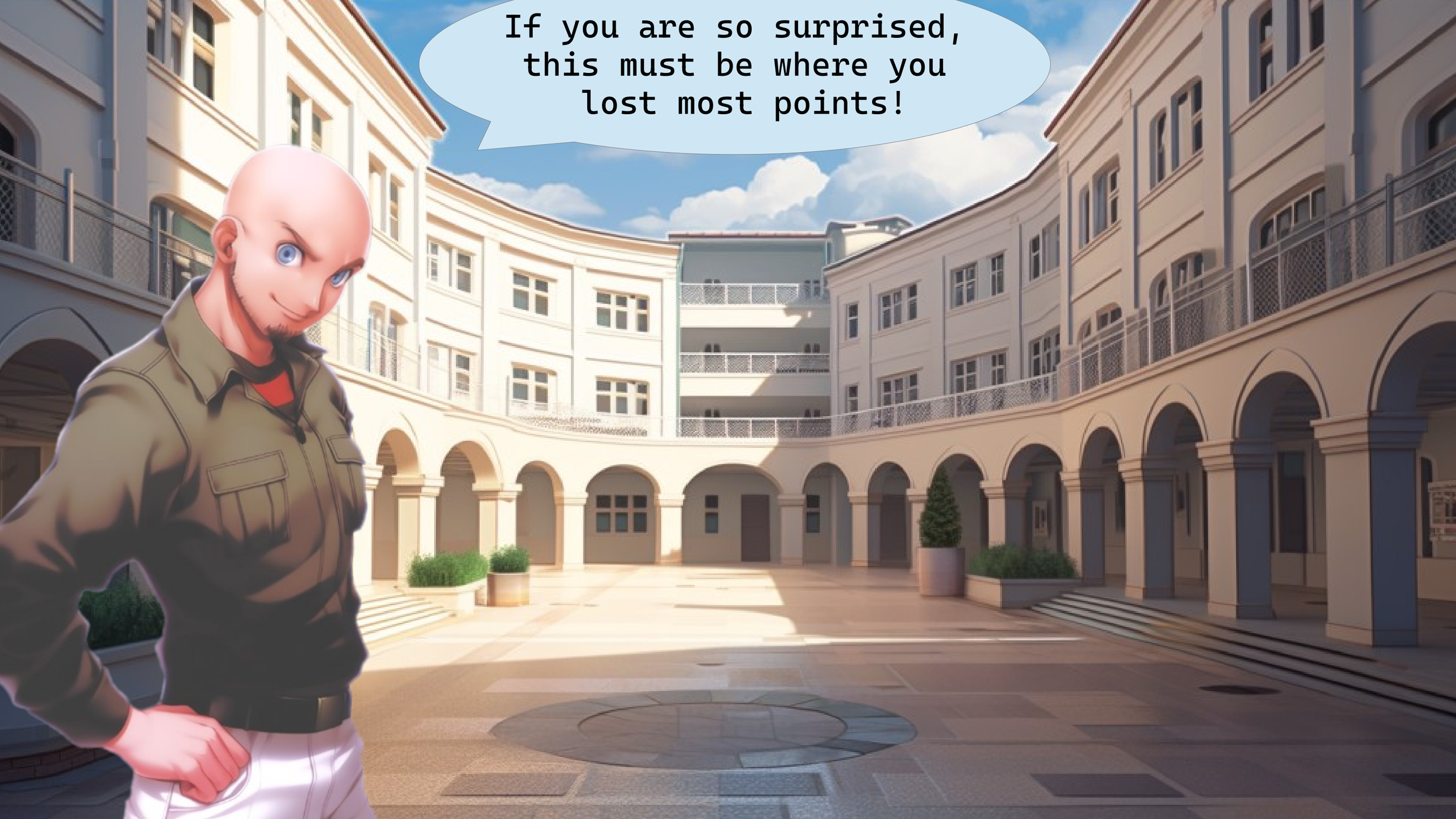
Wait.. why is the empty case an ENUM?!?

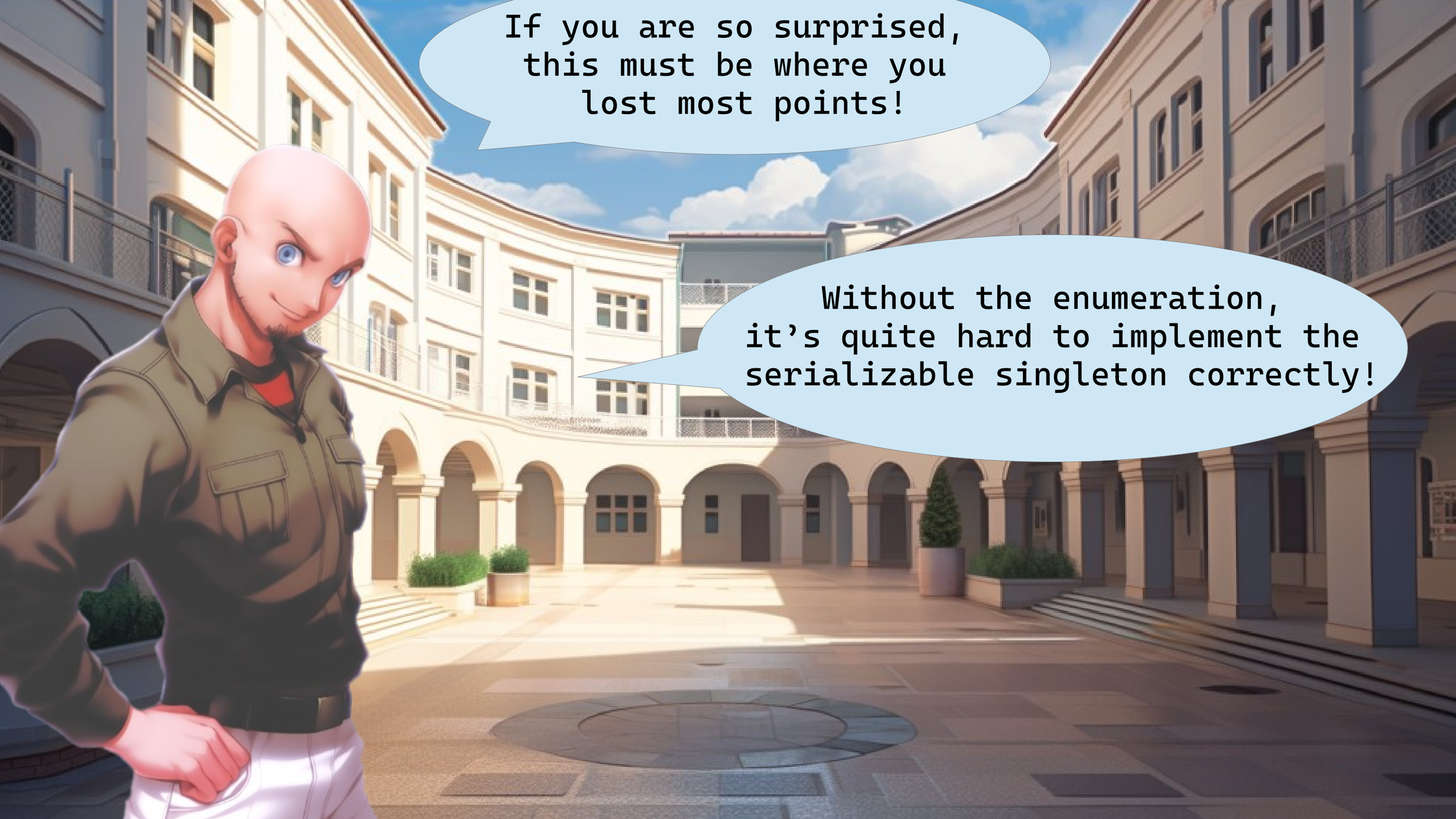
```java
record Some<T>(T get) implements Optional<T>{
  public T orElseGet(Supplier<T> unused){ return get; }
  public Optional<T> or(Supplier<Optional<T>> s){ return this; }
  public <U> Optional<U> map(Function<T, U> m){
    return Optional.ofNullable(m.apply(get));
  }
  public <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Objects.requireNonNull(m.apply(get));
  }
}

enum Empty implements Optional<Object>{ Instance; }
```

Wait.. why is the empty case an ENUM?!?

Not even a reasonable enum, but an absurd enum with a single element!


If you are so surprised, this must be where you lost most points!


If you are so surprised, this must be where you lost most points!
Without the enumeration, it’s quite hard to implement the serializable singleton correctly!

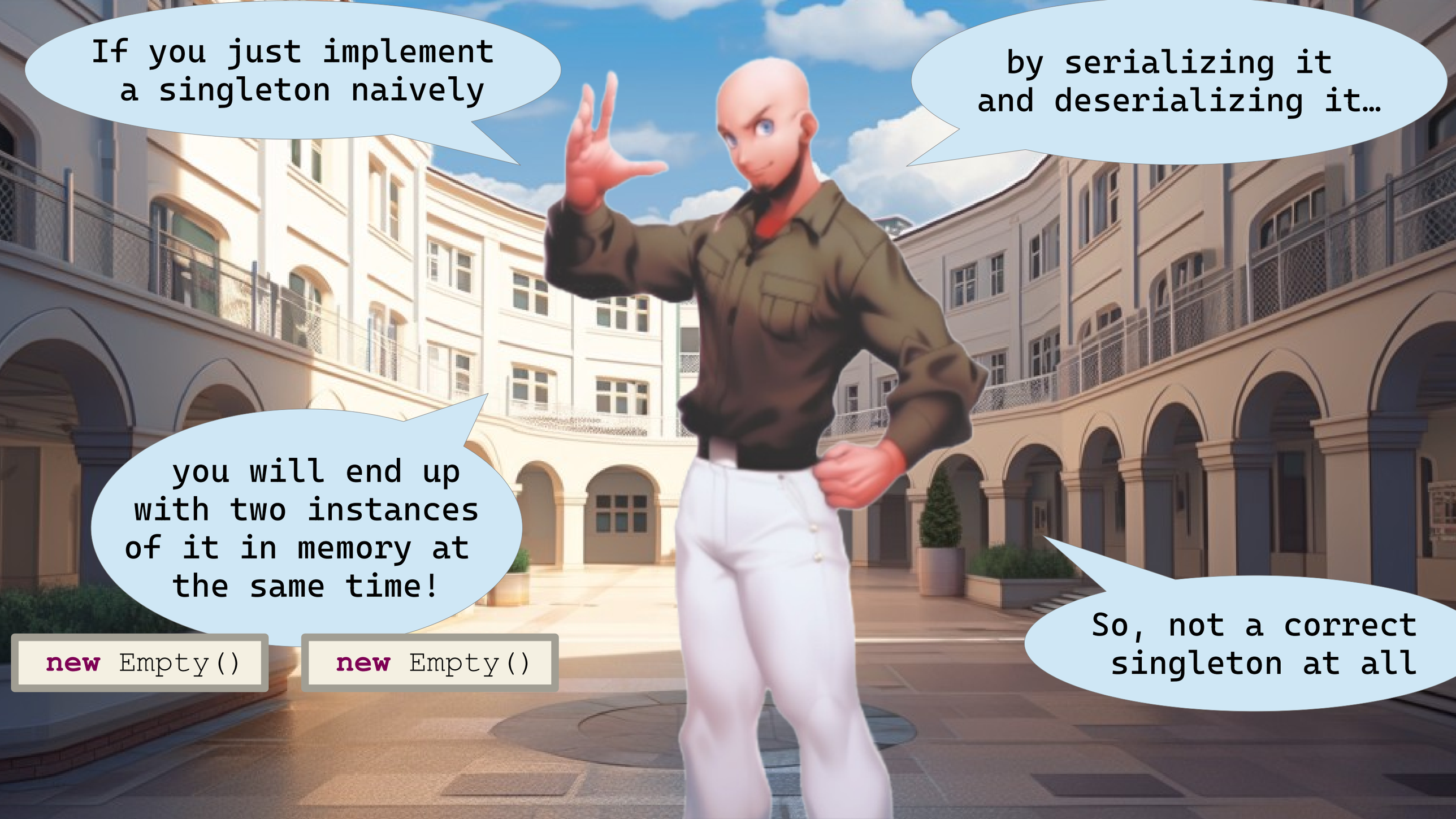

If you just implement
a singleton naively

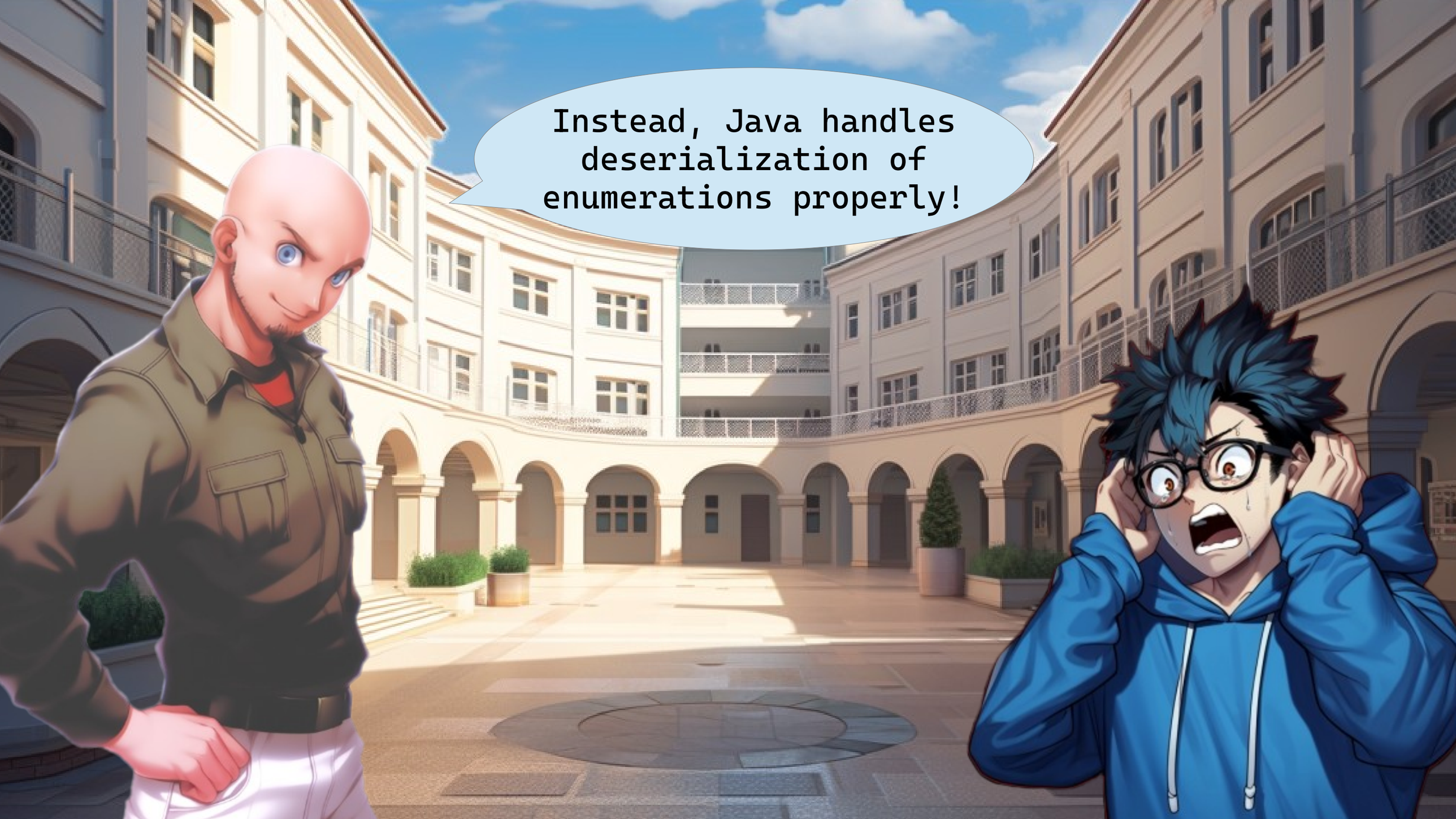

If you just implement a singleton naively
by serializing it and deserializing it…

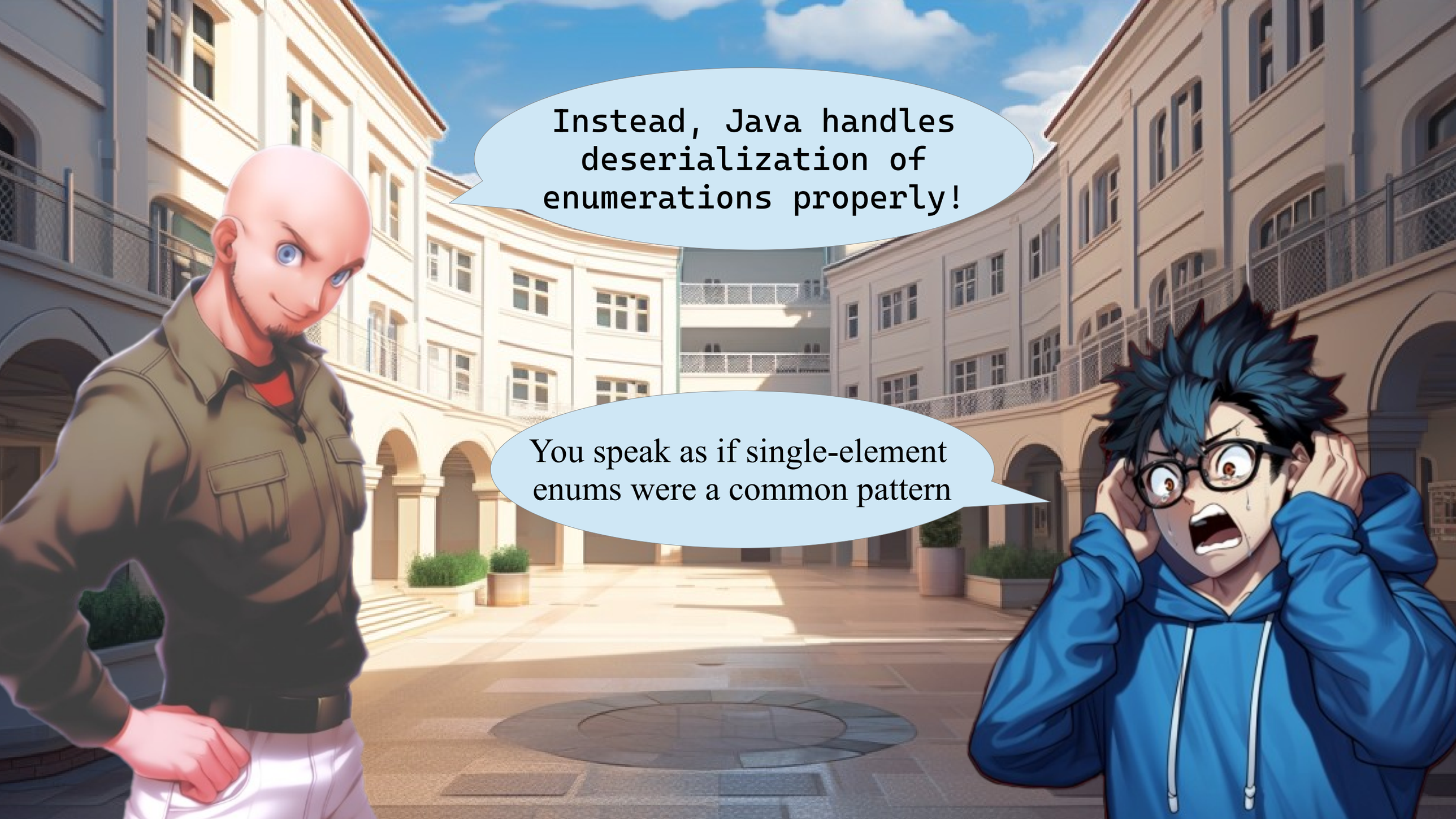

If you just implement a singleton naively
by serializing it and deserializing it…
you will end up with two instances of it in memory at the same time!

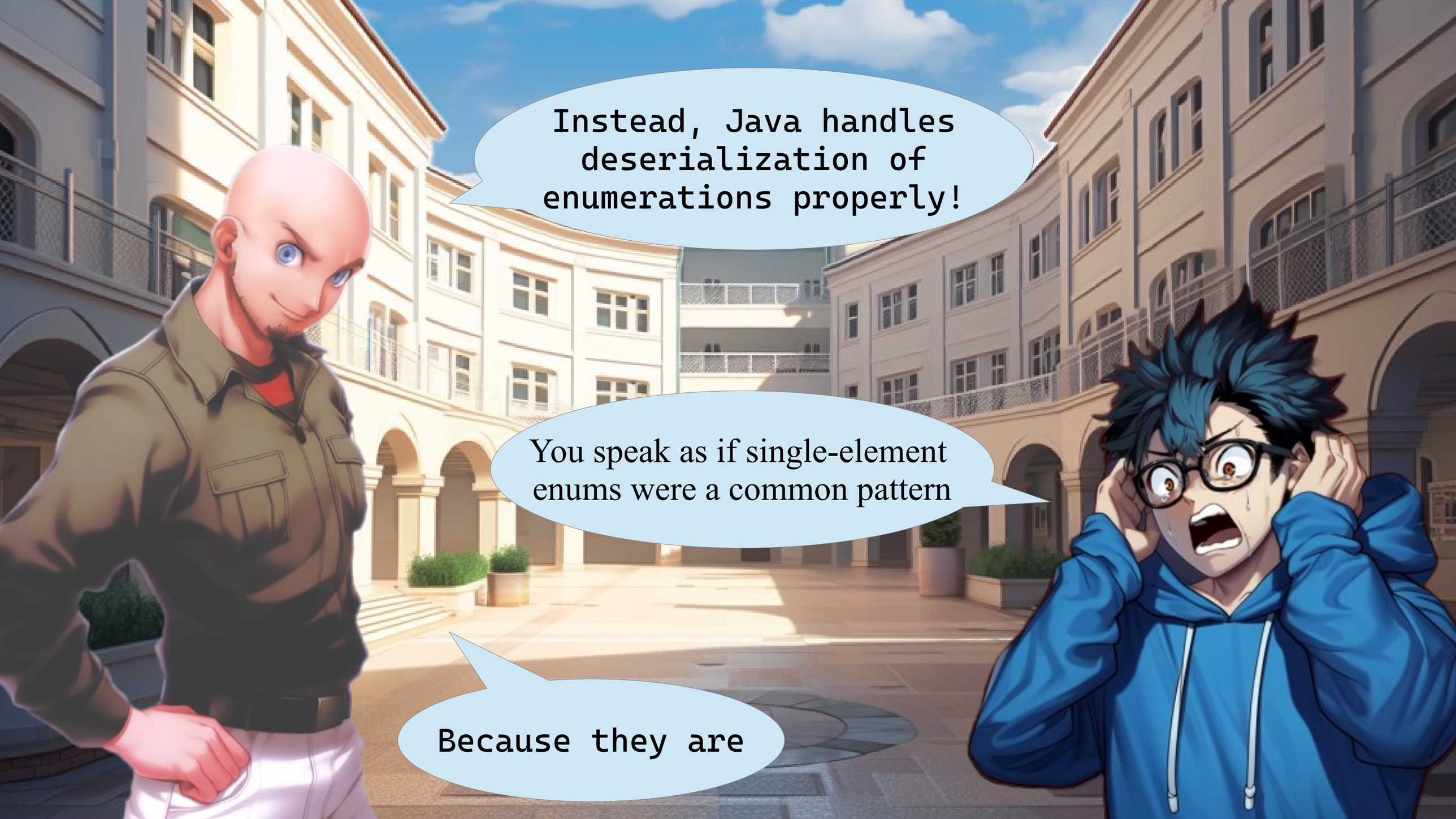

If you just implement a singleton naively
by serializing it and deserializing it…
you will end up with two instances of it in memory at the same time!
new Empty()


If you just implement a singleton naively
by serializing it and deserializing it…
you will end up with two instances of it in memory at the same time!
new Empty()
new Empty()

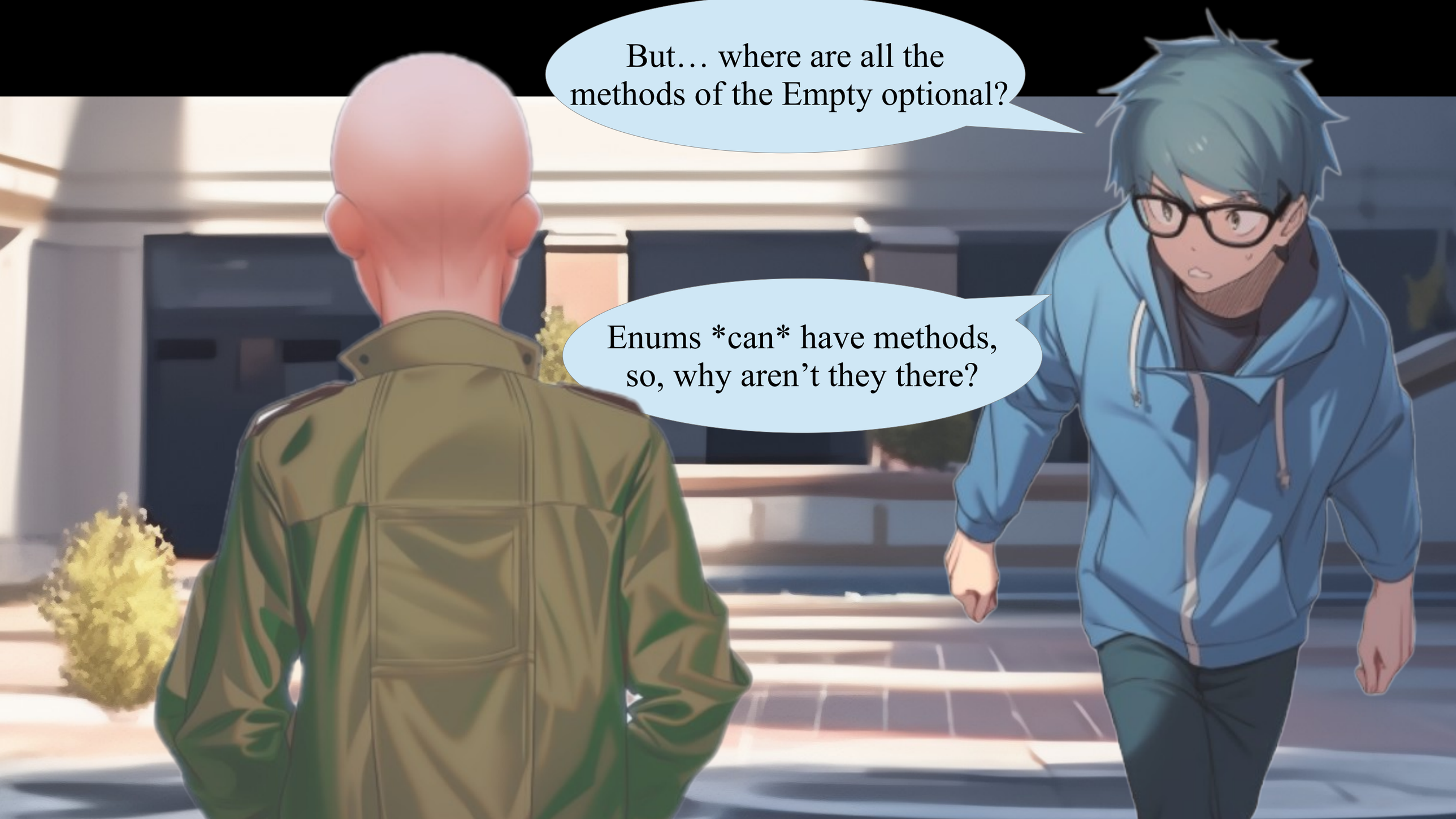

If you just implement a singleton naively
by serializing it and deserializing it…
you will end up with two instances of it in memory at the same time!
new Empty()
new Empty()
So, not a correct singleton at all

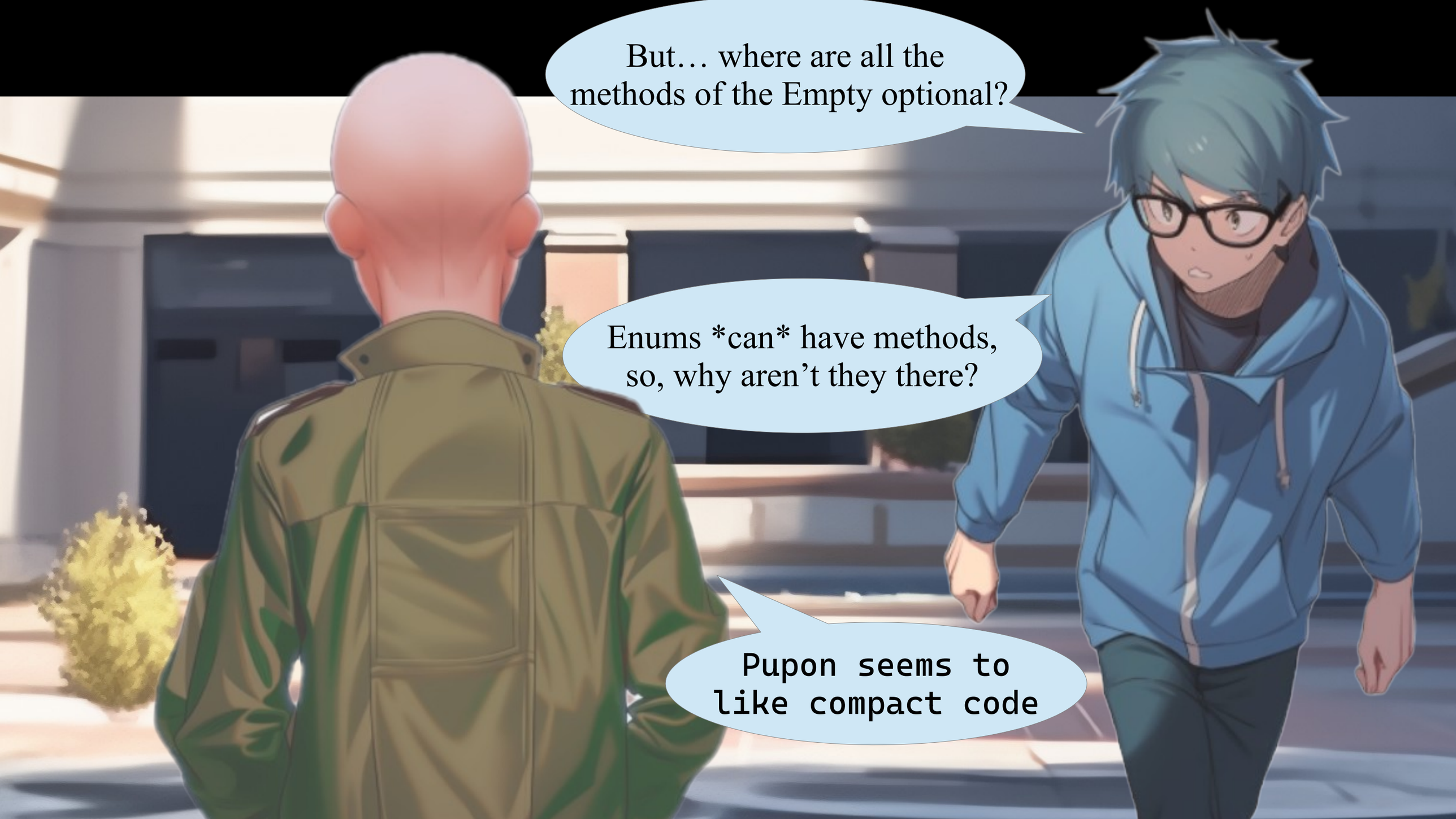

Instead, Java handles deserialization of enumerations properly!


Instead, Java handles deserialization of enumerations properly!
You speak as if single-element enums were a common pattern


Instead, Java handles deserialization of enumerations properly!
You speak as if single-element enums were a common pattern
Because they are


But… where are all the methods of the Empty optional?


But… where are all the methods of the Empty optional?
Enums *can* have methods, so, why aren't they there?


But… where are all the methods of the Empty optional?
Enums *can* have methods, so, why aren't they there?
Pupon seems to like compact code

```java
public sealed interface Optional<T>
    extends Serializable permits Empty, Some<T>{
  @SuppressWarnings("unchecked")
  static <E> Optional<E> empty(){ return (Optional<E>)Empty.Instance; }
  static <T> Optional<T> of(T value){
    return new Some<T>(Objects.requireNonNull(value));
  }
  static <T> Optional<T> ofNullable(T value){
    return value == null ? empty() : new Some<T>(value);
  }
  default T orElseGet(Supplier<T> s){ return s.get(); }
  default Optional<T> or(Supplier<Optional<T>> s){
    return Objects.requireNonNull(s.get());
  }
  default <U> Optional<U> map(Function<T, U> m){ return Optional.em
  default Optional<T> filter(Predicate<T> p){
    return map(e->p.test(e) ? e : null);
  }
  default <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Optional.empty();
  }
}
```

```
public sealed interface Optional<T>
    extends Serializable permits Empty, So
  @SuppressWarnings("unchecked")
  static <E> Optional<E> empty(){ return (Optional<E>)Empty.i      nce; }
  static <T> Optional<T> of(T value){
    return new Some<T>(Objects.requireNonNull(value));
  }
  static <T> Optional<T> ofNullable(T value){
    return value == null ? empty() : new Some<T>(value);
  }
  default T orElseGet(Supplier<T> s){ return s.get(); }
  default Optional<T> or(Supplier<Optional<T>> s){
    return Objects.requireNonNull(s.get());
  }
  default <U> Optional<U> map(Function<T, U> m){ return Optional.em
  default Optional<T> filter(Predicate<T> p){
    return map(e->p.test(e) ? e : null);
  }
  default <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Optional.empty();
  }
}
```

There's no need to declare them as abstract in Optional

```
public sealed interface Optional<T>
    extends Serializable permits Empty, So
  @SuppressWarnings("unchecked")
  static <E> Optional<E> empty(){ return (Optional<E>)
  static <T> Optional<T> of(T value){
    return new Some<T>(Objects.requireNonNull(value));
  }
  static <T> Optional<T> ofNullable(T value){
    return value == null ? empty() : new Some<T>(value);
  }
  default T orElseGet(Supplier<T> s){ return s.get(); }
  default Optional<T> or(Supplier<Optional<T>> s){
    return Objects.requireNonNull(s.get());
  }
  default <U> Optional<U> map(Function<T, U> m){ return Optional.em
  default Optional<T> filter(Predicate<T> p){
    return map(e->p.test(e) ? e : null);
  }
  default <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Optional.empty();
  }
}
```

There's no need to declare them as abstract in Optional

only to repeat the implementation in None

```
public sealed interface Optional<T>
    extends Serializable permits Empty, So
  @SuppressWarnings("unchecked")
  static <E> Optional<E> empty(){ return (Optional<E>)
  static <T> Optional<T> of(T value){
    return new Some<T>(Objects
  }
  static <T> Optic
    return value == n
  }
  default T orElseGet(Supplier<T> s){ return s.get(); }
  default Optional<T> or(Supplier<Optional<T>> s){
    return Objects.requireNonNull(s.get());
  }
  default <U> Optional<U> map(Function<T, U> m){ return Optional.em
  default Optional<T> filter(Predicate<T> p){
    return map(e->p.test(e) ? e : null);
  }
  default <U> Optional<U> flatMap(Function<T, Optional<U>> m){
    return Optional.empty();
  }
}
```

There's no need to declare them as abstract in Optional

only to repeat the implementation in None

Writing the Empty implementation directly in Optional is more compact

Is being compact for the sake of compactness any good?

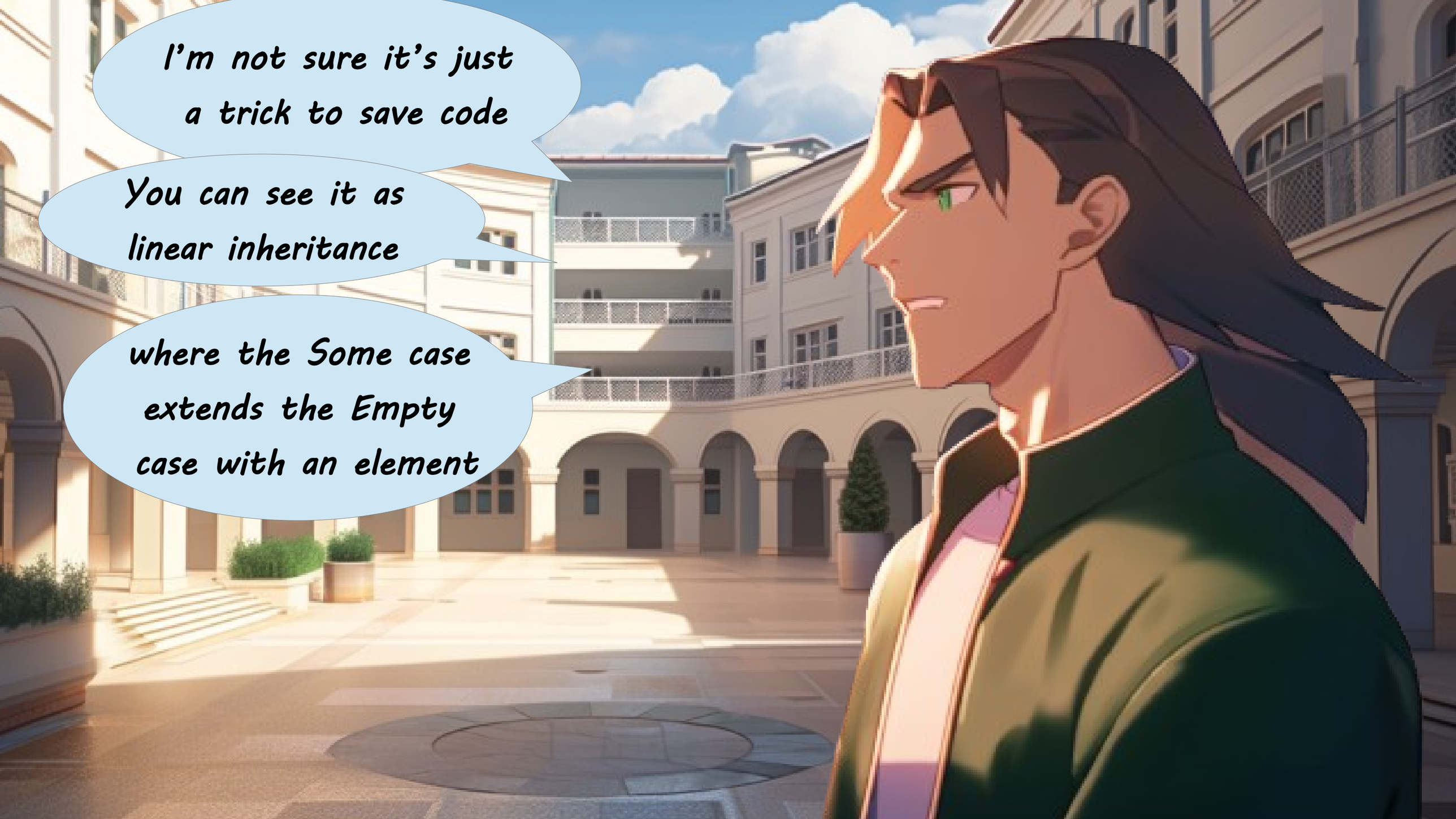

Is being compact for the sake of compactness any good?
This is confusing

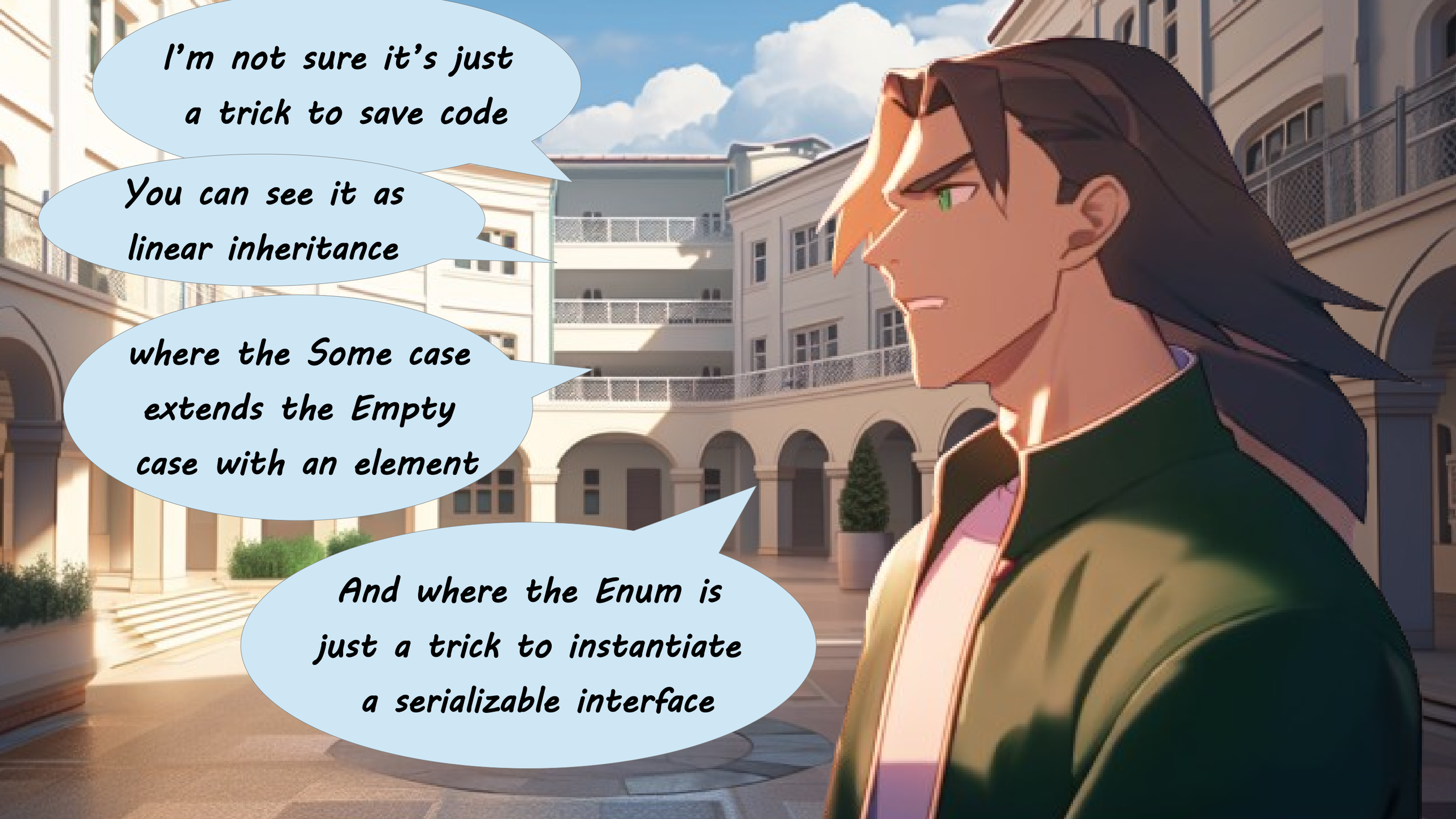

Is being compact for the sake of compactness any good?
This is confusing
The optional interface is neither empty nor full, so it should not be implemented as Empty.


Is being compact for the sake of compactness any good?
This is confusing
The optional interface is neither empty nor full, so it should not be implemented as Empty.
Who cares, behavior is what matters


I'm not sure it's just
a trick to save code


I'm not sure it's just a trick to save code
You can see it as linear inheritance


I'm not sure it's just a trick to save code
You can see it as linear inheritance
where the Some case extends the Empty case with an element


I'm not sure it's just a trick to save code
You can see it as linear inheritance
where the Some case extends the Empty case with an element
And where the Enum is just a trick to instantiate a serializable interface


Interfaces have no state


Interfaces have no state
The Empty enum also has no state


Interfaces have no state
The Empty enum also has no state
Without the serialization issues, Pupon would have probably used an empty anonymous inner class


```
static <E> Optional<E> empty(){ return new Optional<>(){}; }
```


Interfaces have no state
The Empty enum also has no state
Without the serialization issues, Pupon would have probably used an empty anonymous inner class
And you wouldn't be complaining so much in that case
static <E> Optional<E> empty(){ return new Optional<>(){}; }

```
public sealed interface Optional<T> extends Serializable permits Empty, Some<T>{
  @SuppressWarnings("unchecked")
  static <E> Optional<E> empty(){ return (Optional<E>)Empty.Instance; }
  static <T> Optional<T> of(T value){ return new Some<T>(Objects.requireNonNull(value)); }
  static <T> Optional<T> ofNullable(T value){
    return value == null ? empty() : new Some<T>(value);
  }
  default T orElseGet(Supplier<T> s){ return s.get(); }
  default Optional<T> or(Supplier<Optional<T>> s){ return Objects.requireNonNull(s.get()); }
  default <U> Optional<U> map(Function<T, U> m){ return Optional.empty(); }
  default Optional<T> filter(Predicate<T> p){ return map(e->p.test(e) ? e : null); }
  default <U> Optional<U> flatMap(Function<T, Optional<U>> m){ return Optional.empty(); }
}

enum Empty im                                  t>{ Instance; }

record                                                  T>{
  pub                                                  urn get; }
  pu                                                  > s){ return this; }
  pu                                                  m){
    re                                                  );
  }
  public <U                                          ion<T, Optional<U>> m){
    return Objects                                  ull(m.apply(get));
  }
}
```

Should they discuss filter too?

May be not?


And it is now time to complete the first year ending ceremony


First, if you are
one of the 58 students


First, if you are one of the 58 students
who completed at least one question


First, if you are one of the 58 students
who completed at least one question
please form a line in front of Pupon and Pumpkin

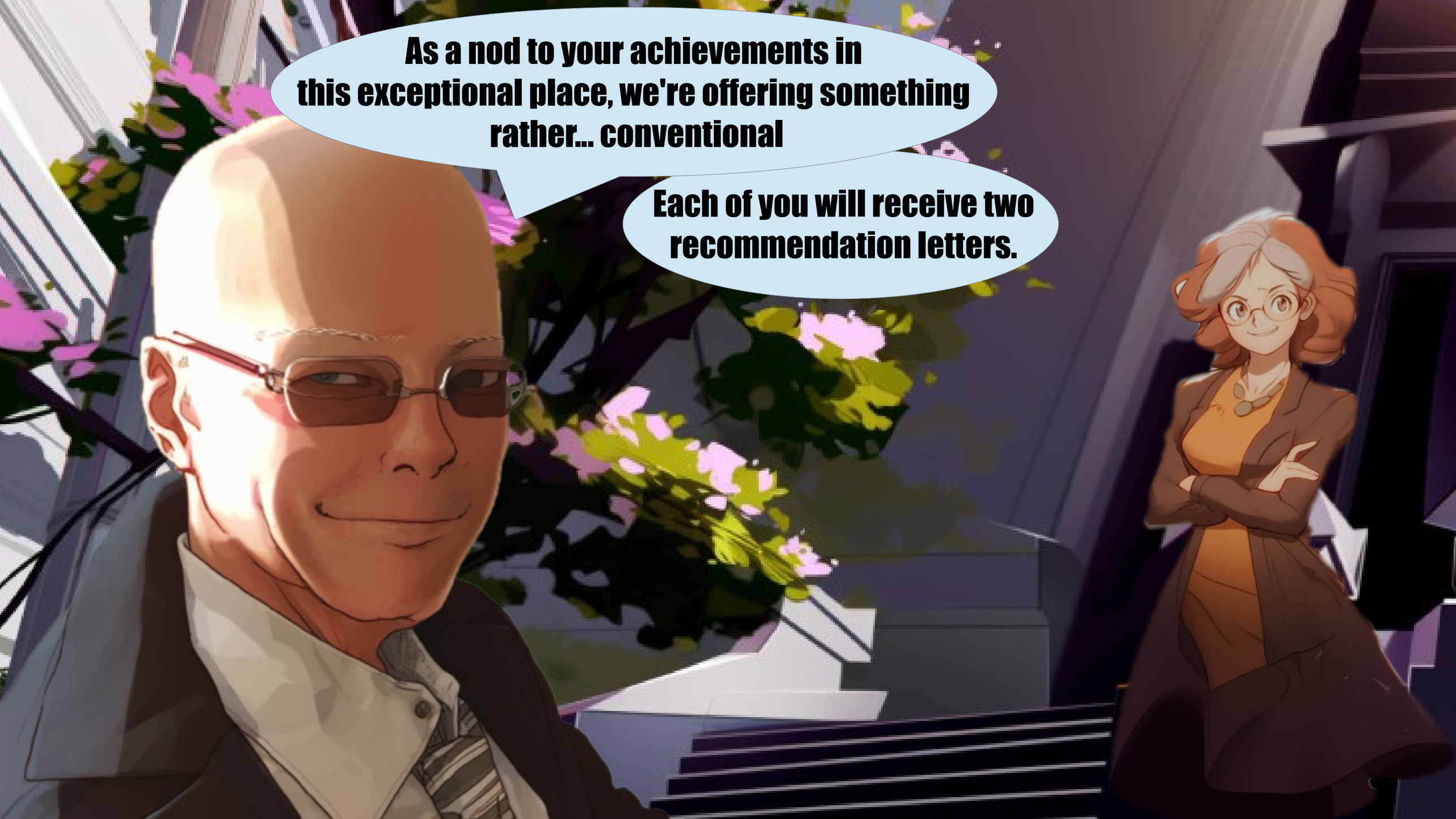

Dear students, as we reach the end of this phase at UPU, it's clear that our paths diverge here

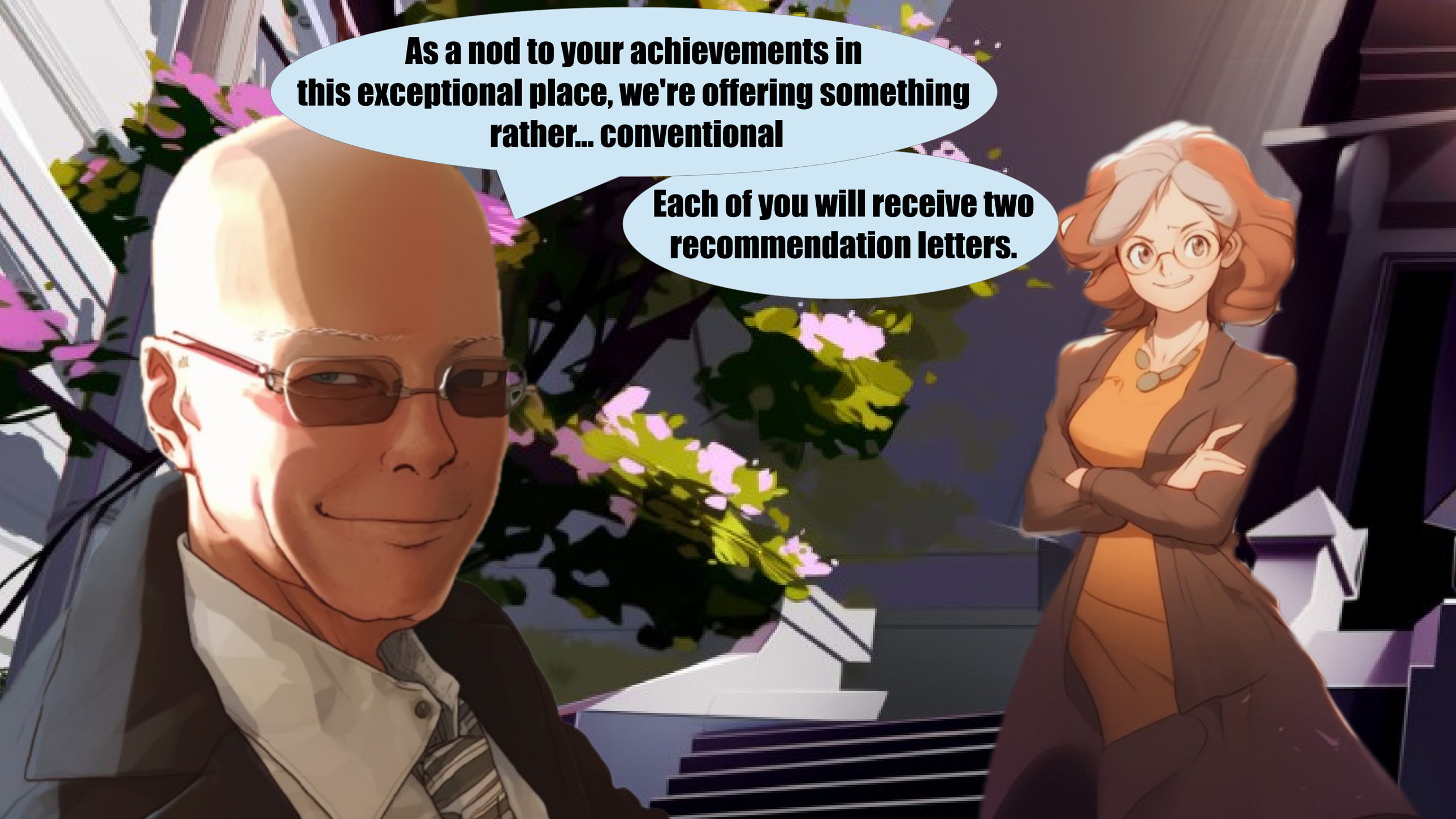

Dear students, as we reach the end of this phase at UPU, it's clear that our paths diverge here
We cannot let you go forward into UPU

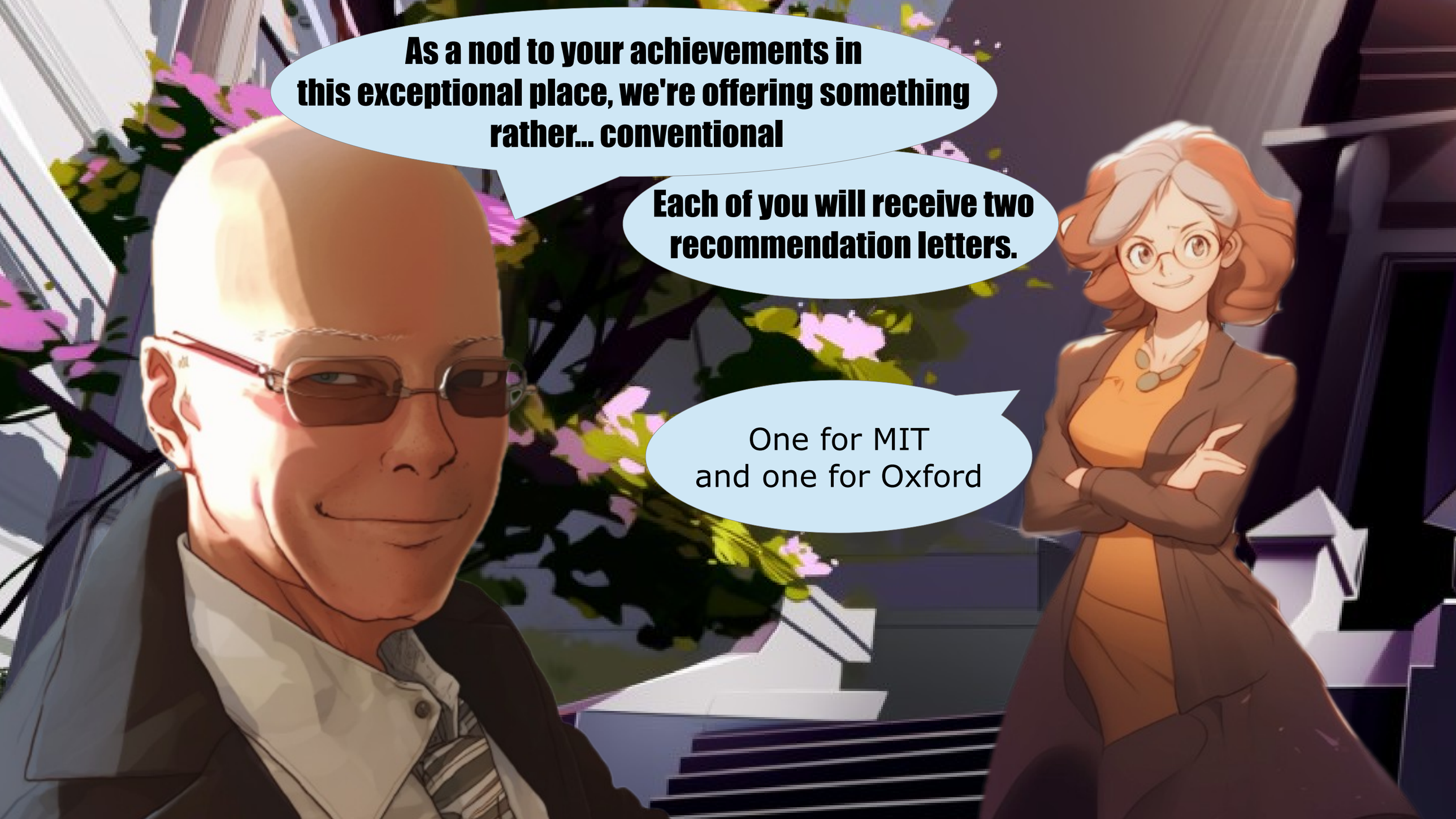

Dear students, as we reach the end of this phase at UPU, it's clear that our paths diverge here
We cannot let you go forward into UPU
However

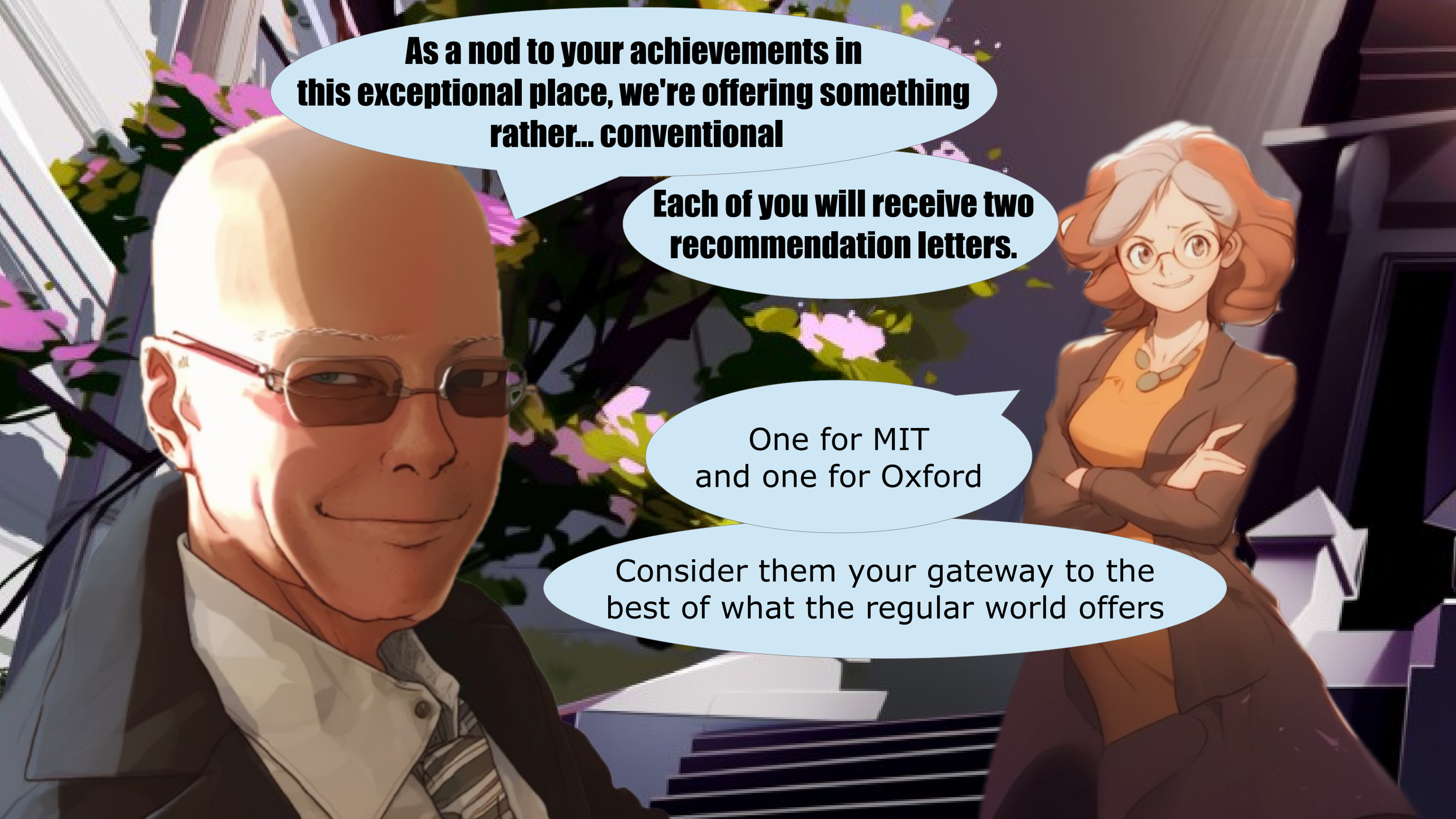

Dear students, as we reach the end of this phase at UPU, it's clear that our paths diverge here
We cannot let you go forward into UPU
However
your skills haven't gone unnoticed

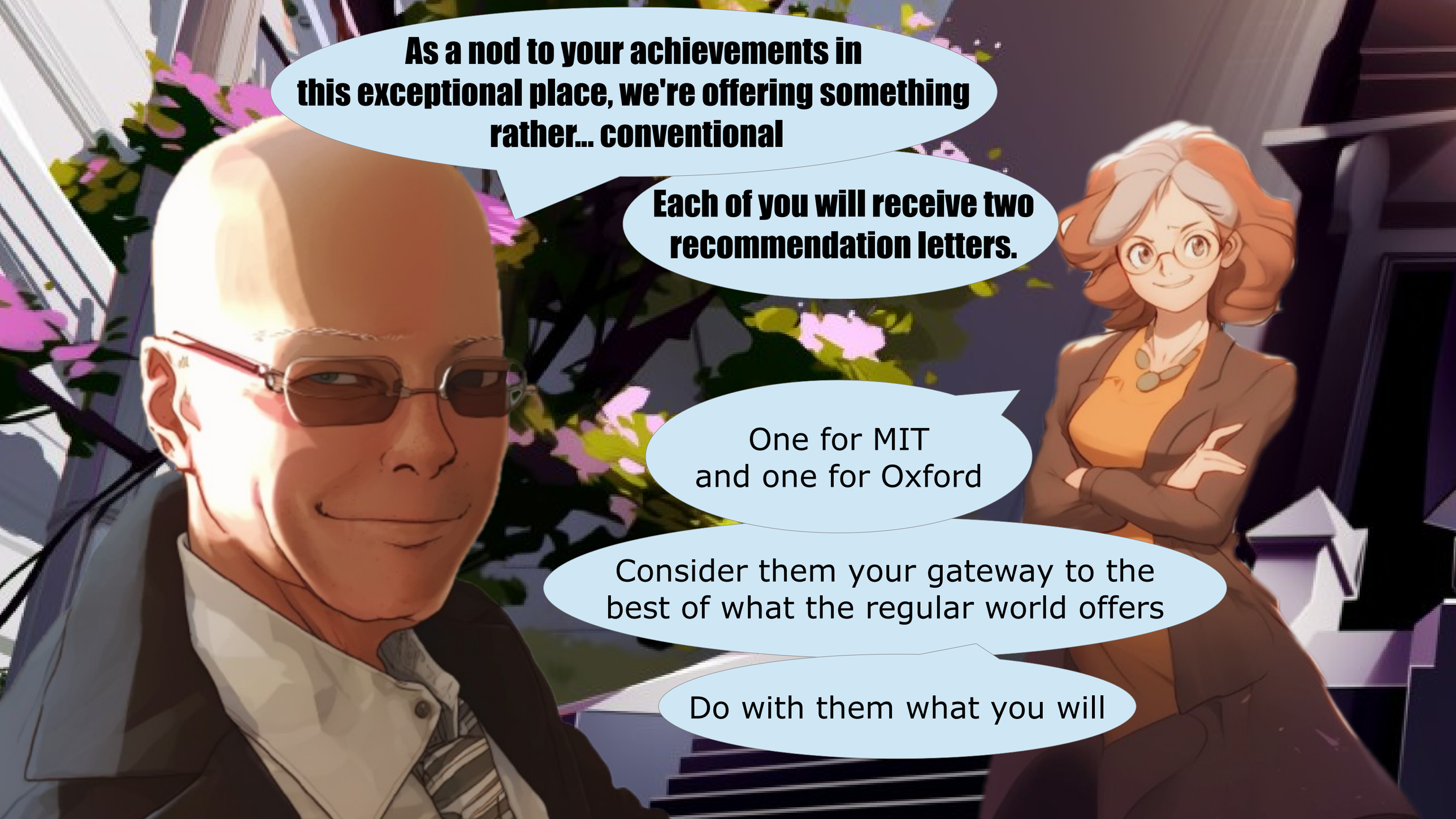

As a nod to your achievements in this exceptional place, we're offering something rather... conventional


As a nod to your achievements in this exceptional place, we're offering something rather... conventional
Each of you will receive two recommendation letters.


As a nod to your achievements in this exceptional place, we're offering something rather... conventional
Each of you will receive two recommendation letters.


As a nod to your achievements in this exceptional place, we're offering something rather... conventional
Each of you will receive two recommendation letters.
One for MIT and one for Oxford


As a nod to your achievements in this exceptional place, we're offering something rather... conventional
Each of you will receive two recommendation letters.
One for MIT and one for Oxford
Consider them your gateway to the best of what the regular world offers


As a nod to your achievements in this exceptional place, we're offering something rather... conventional
Each of you will receive two recommendation letters.
One for MIT and one for Oxford
Consider them your gateway to the best of what the regular world offers
Do with them what you will


Yes, they might not
be good enough for UPU


Yes, they might not be good enough for UPU
but they'll definitely thrive in normal universities like those


Yes, they might not be good enough for UPU
but they'll definitely thrive in normal universities like those
What… What?!?


Wait, does this mean that if we failed one question, we could've then moved on to Oxford?


Yes


Yes
basically they've lost a year
but they'll get a good push forward
for their future anyway


Yes
basically they've lost a year
but they'll get a good push forward
for their future anyway
They discussed this
the week you were sick...
sorry we forgot to tell you


Yes
basically they've lost a year but they'll get a good push forward for their future anyway
They discussed this the week you were sick... sorry we forgot to tell you
Guess it doesn't matter much now!