GPT-3 as a few-shot pattern recognizer

Yoav Goldberg

Preliminaries

- Language modeling
- Transformer
- GPT/BERT/GPT2/...
- Make it larger

Very impressive generation capacity

some examples: https://www.gwern.net/GPT-3

...but not the claim-for-fame of the paper

Language Models are Few-Shot Learners

Tom B. Bro	wn* Benjamin	Mann* Nick I	Ryder* Melanie Subbiah*	
Jared Kaplan [†]	Prafulla Dhariwal	Arvind Neelakantan	Pranav Shyam	Girish Sastry
Amanda Askell	Sandhini Agarwal	Ariel Herbert-Voss	Gretchen Krueger	Tom Henighan
Rewon Child	Aditya Ramesh	Daniel M. Ziegler	Jeffrey Wu	Clemens Winter
Christopher He	esse Mark Chen	Eric Sigler	Mateusz Litwin	Scott Gray
Benjamin Chess		Jack Clark Christopher Berner		Berner
Sam McCandlish Alec Ra		dford Ilya Su	utskever I	Dario Amodei

...but not the claim-for-fame of the paper

and I agree, few-shot aspects are way more impressive.

Language Models are Few-Shot Learners

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Christopher He	esse Mark Chen	Eric Sigler	Mateusz Litwin	Scott Gray	
Benjamin Chess		Jack Clark Christopher Berner		Berner	
Sam McCandlish Alec Ra		dford Ilya S	utskever I	Dario Amodei	

Me a few years ago

- Q: What will you do with a budget of 100M dollars?
- Yoav: Train a huge LM on all the internet, just to show people it doesn't solve language understanding.

did GPT 3 change things?

Playing with GPT 3





Q: Who were the founders of Microsoft?

A: Bill Gates and Paul Allen were the founders of Microsoft.

Q: How many companies did Bill Gates found?

A: Bill Gates founded two companies: Microsoft and Corbis.

Q: What does the second company do?

A: Corbis is a digital image company.

Q: What are cubs and cowboys?

A: Cubs are baby bears. Cowboys are people who work on ranches.

Q: What do cubs and cowboys have in common?

A: Both cubs and cowboys are young.

Q: What do the words 'cubs' and 'cowboys' have in common?

A: Both words start with the letter 'c'.

Q: What do the words 'cubs', 'cowboys' and 'dolphins' have in common?

A: All three words start with the letter 'c'.

0.





Inject structural text (start sequence, reset sequence)

Q: Who were the founders of Microsoft?

A: Bill Gates and Paul Allen were the founders of Microsoft.

Q: How many companies did Bill Gates found?

A: Bill Gates founded two companies: Microsoft and Corbis.

Q: What does the second company do?

nice coref!

A: Corbis is a digital image company.

Q: What are cubs and cowboys?

A: Cubs are baby bears. Cowboys are people who work on ranches.

not what i meant, but ok.

Q: What do cubs and cowboys have in common?

A: Both cubs and cowboys are young.

Q: What do the words 'cubs' and 'cowboys' have in common?

A: Both words start with the letter 'c'.

Q: What do the words 'cubs', 'cowboys' and 'dolphins' have in common?

A: All three words start with the letter 'c'.

uh...

0.





Q: What do the words 'dolphins' and 'eagles' have in common?

A: Both words start with the letter 'e'.

Q: Does the word 'dolphins' start with the letter 'e'?

A: Yes, the word 'dolphins' starts with the letter 'e'.

Q: What do dolphins and eagles have in common?

A: Both are birds.

Q: Are dolphins birds?

A: No, dolphins are mammals.

Q: Who wrote a book without the letter e?

A: Mark Twain wrote a book without the letter e.

Q: Who else wrote a book without the letter e?

A: Lewis Carroll wrote a book without the letter e.

Q: What was it called?

A: It was called "Through the Looking-Glass".

Q: Did Mark Twain write a book without the letter e?

A: Yes, Mark Twain wrote a book without the letter e.

Q: Did George Perec write a book without the letter e?

A: Yes, George Perec wrote a book without the letter e.

Q: Is there an author who didn't write a book without the letter e?

A: No, there is no author who didn't write a book without the letter e.

Q: Did all authors wrote a book without the letter e?

A: No, not all authors wrote a book without the letter e.

Climbing towards NLU: On Meaning, Form, and Understanding in the Age of Data

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GPT-3, Bloviator: OpenAl's language generator has no idea what it's talking about

Tests show that the popular AI still has a poor grasp of reality.

by Gary Marcus and Ernest Davis

August 22, 2020

Let's get back to the interesting stuff:

Language Models are Few-Shot Learners

what IS exciting about it?

Prompt:

Q: one

A: 1

Q: two

A: 2

GPT3 Answers:

Q: one hundred and five

A: 105

Q: three thousands and fifty six

A: 3566

Q: five thousand and four

A: 50004

Q: five

A: 5

Q: fiteen

A: 15

Q: twelve plus four

A: 16

Pluralization



This is a wug. Now there are two of them, there are two wugs. And now there are three wugs.

This is a muggle. Now there are two of them. there are two muggles. And now there are three muggles.

This is a man. Now there are two of them, there are two men. And now there are three men.

This is a tennis court. Now there are two of them. There are two tennis courts. And now there are three tennis courts.

This is a bottle of wine. Now there are two of them. There are two bottles of wine. And now there are three bottles of wine.

This is a gavagai. Now there are two of them. There are two gavagai. And now there are three gavagai.

This is a octopus. Now there are two of them. There are two octopi. And now there are three octopi.

This is a jorkipus. Now there are two of them. There are two jorkipus. And now there are three jorkipus.

This is a jorkpad. Now there are two of them. There are two jorkpads. And now there are three jorkpads.

Harder Pluralization (multi-word)

This is a jorkpaa. How there are two or them. There are two jorkpaas. And how there are three jorkpaas.

This is Alex. Now there are two of them. There are two Alexes. And now there are three Alexes.

This is a blork of gonk. Now there are two of them. There are two blorks of gonk. And now there are three blorks of gonk.

This is a gonk blork. Now there are two of them. There are two gonk blorks. And now there are three gonk blorks.

This is a boy and a girl. Now there are two of them. There are two boys and a girl. And now there are three boys and a girl.

These are a boy and a girl. Now there are two of them. There are two boys and a girl. And now there are three boys and a girl.

This is a cat in a hat. Now there are two of them. There are two cat in hats. And now there are three cat in hats.

This is a hat on a cat. Now there are two of them. There are two hat on cats. And now there are three hat on cats.

Fused-heads / numbers / "Yanai's task"

Q: She just turned 50

A: age

Q: She was going 50 on the highway

A: speed

n. opecu

Q: She paid 50 for them.

A: price

Q: Nice donuts! I'll take 50.

A: quantity

Q: I can give you 50 for these, but not more.

A: price

Q: I'll take 50 of these, but not more.

A: quantity

Q: I can give you 50 of these, but not more.

A: quantity

Q: I'll take these at 50, but not more.

A: price

Q: I can give you these for 50

A: price

Q: Taking this turn at 50 is dangerous

A: speed

Q: take the first item from a list

A: Ist[0]

Q: take the last item from a list

A: lst[-1]

Q: verify that the list has at least 4 items

A: Ist.length >= 4

Q: verify that the list has more then 4 items

A: Ist.length > 4

Q: add the numer 1 to a list

A: Ist.add(1)

Q: add the numbers 1, 2 and 3 to a list

A: Ist.add(1, 2, 3)

Q: add the strings 'a', 'b' and 'c' to a list

A: lst.add('a', 'b', 'c')

Q: verify that the last item in a list of numbers is larger than 4

A: lst.last > 4

Q: take the first item from a list

A: lst[0]

Q: take the last item from a list

A: Ist[-1]

Q: verify that the list has at least 4 items

A: lst.length >= 4

Q: verify that the list has more then 4 items

A: Ist.length > 4

Q: add the numer 1 to a list

A: lst.add(1)

Q: add the numbers 1, 2 and 3 to a list

A: lst.add(1, 2, 3)

Q: add the strings 'a', 'b' and 'c' to a list

A: lst.add('a', 'b', 'c')

Q: verify that the last item in a list of numbers is larger than 4

A: lst.last > 4

in the python programming language:

Q: take the first item from a list

A: lst[0]

Q: take the last item from a list

A: Ist[-1]

Q: verify that the list has at least 4 items

A: len(lst) > 4

Q: verify that the list has 5 items or more

A: len(lst) >= 5

Q: verify that the list has 3 items

A: len(lst) == 3

Q: add the numer 1 to a list

A: lst.append(1)

Q: add the numbers 1, 2 and 3 to a list

A: lst.extend([1, 2, 3])

Q: add the strings 'a', 'b' and 'c' to a list

A: lst.extend(['a', 'b', 'c'])

Q: verify that the last item in a list of numbers is large

A: lst.pop() > 4

Q: verify that the last item in a list of numbers is large

A: lst.pop() >= 4

Q: find the largest number in a list

A: max(lst)

Q: find the second largest number in a list

A: second(Ist)

Q: find the 5th largest number in a list

A: fifth(lst)

Q: find the largest number in a list

A: max(lst)

Q: find the second largest number in a list

A: second(lst)

Q: find the 5th largest number in a list

A: fifth(lst)

Q: find the 5th smallest number in a list

A: fifth(lst, reverse=True)

Q: find the second smallest number in a list

A: second(lst, reverse=True)

Q: find the second smallest number in a list, the list is not sorted.

A: second(lst, key=lambda x: x[1])

Q: find the second smallest number in a non-sorted list.

A: second(lst, key=lambda x: x[1], reverse=True)

Out-of-the-box language understanding: meh

Playground



A&Q



John entered the living room. John put down the candle and picked up the axe. He went to the great hall. He dropped the axe. He then entered the kitchen.

Q: where is John?

A: in the kitchen

Q: Where is the candle?

A: in the living room

Q: Where did John find an axe?

A: in the great hall

Q: Where is the axe now?

A: in the kitchen

Q: What is John holding now?

A: the candle

But it is great on form: (passivization)

Q: I broke the window. A: The window broke. Q: I hit the donkey. A: The donkey was hit. Q: I saved the day. A: The day was saved. Q: I gracefully saved the day A: The day was gracefully saved. Q: I hit the donkey with a stick. A: The donkey was hit with a stick. Q: I ate the donuts with great pleasure. A: The donuts were eaten with great pleasure. Q: I shot the sherif A: The sherif was shot. Q: I did not shoot the deputy A: The deputy was not shot. Q: Sam shot the country sheriff on Wednesday A: The country sheriff was shot on Wednesday. Q:

But it is great on form: (passivization)

Playground



A&Q



Q: I broke the window.

A: The window broke.

Q: I hit the donkey.

A: The donkey was hit by me.

Q: I saved the day.

A: The day was saved by me.

Q: I shot the Sheriff on Wednesday.

A: The Sheriff was shot by me on Wednesday.

Q: John shot the Sheriff on Wednesday.

A: The Sheriff was shot by John on Wednesday.

Q: She shot the Sheriff in the butt.

A: The Sheriff was shot in the butt by her.

Q: He did not visit Sam every day.

A: Sam was not visited by him every day.

Q: He decided to visit Sam every day.

A: Sam was decided to be visited by him every day.

Question formation

Q: I broke the window. A: What did I break? Q: I saved the day. A: What did I save? Q: I gracefully saved the day A: What did I gracefully save? Q: I was gracefully saving the day. A: What was I gracefully saving? Q: I gave John flowers. A: Who did I give flowers to? Q: I gave her a rose and a guitar. A: Who did I give a rose and a guitar to? Q: I gave the best person in the room a rose and a guitar. A: Who did I give the best person in the room a rose and a guitar? Q: I gave the kids candies. A: Who did I give candies to? Q: I gave the kids in the room candies.

A: Who did I give candies to in the room?

Question formation





Q: I grow flowers in the attic. attic.

A: Where do I grow flowers?

Q: I grow flowers in the attic. I.

A: Who grows flowers in the attic?

Q: He was saved by the bell. He.

A: Who was saved by the bell?

Q: He was saved by the bell. bell.

A: What saved him?

Q: I chased the intruders away, intruders.

A: Who chased the intruders away?

Q: I chased the intruders away. I.

A: Who chased the intruders away?

Q: I chased away the intruders. intruders.

A: Who chased away the intruders?

Q: I chased the intruders away, away,

A: Where did you chase the intruders?

Q: I bought pizza and soda for 4 dollars, pizza and soda.

A: What did you buy for 4 dollars?

Q: I bought pizza and soda for 4 dollars. I.

A: Who bought pizza and soda for 4 dollars?

Q: I bought pizza and soda for 4 dollars. 4 dollars.

A: How much did you buy pizza and soda for?

Q: After lunch, I went to sleep for an hour. an hour.

A: How long did you sleep after lunch?

Q: After lunch, I went to sleep for an hour. Sleep.

A: What did you do after lunch?

Q: After lunch, I want to sleep for an hour. lunch.

A: What did you do after lunch?

Q: After lunch, I want to sleep for an hour. After lunch.

A: What did you do after lunch?

Noun compound interpretation

Q: food producer

A: producer of food

Q: olive oil

A: oil made of olives

Q: baby oil

A: oil for babies

Q: drug manufacturer

A: producer of drugs

Q: age limit

A: limit of age

Q: afternoon meeting

A: meeting in the afternoon

Q: steel pipe

A: pipe made of steel

Q: wooden table

A: table made of wood

Q: heart attack

A: attack of the heart

Q: cardiac arrest

A: arrest of the heart

Q: house wine

A: wine for the house

Q: watermelon juice

A: juice made of watermelons

Q: red wine

A: wine made of red grapes

Q: cookie cutter

A: cutter for cookies

Q: sourdough bread

A: bread made of sourdough

Q: house shoes

A: shoes for the house

Noun compound interpretation

Q: beach house

A: house on the beach
Q: beach shirt
Q: beach shirt
Q: sea bass
A: bass from the sea
Q: sea shore

Q: beach day

A: day at the beach

Q: race horse
A: knob for the door

Q: trash can

A: can for trash

A: bot for artificial intelligence

Q: class president
Q: gpt3 demo
A: president of a class

Q: picture frame

A: demo of Google PageSpeed Insights

A: shore by the sea

Q: door knob

A: frame for pictures

Q: ai demo

Q: head damage

A: demo of artificial intelligence

A: damage to the head
Q: page size
A: bits of a dog
A: bits of a dog

A: bite of a dog

Q: entrance door

Q: picture frame

A: door for entering A: frame for pictures

Q: front porch
A: porch in front
Q: back door
Q: sea side
A: side by the sea

A: door for exiting

Q: submit button

Q: cash prize

A: button for submitting

A: prize for cash
Q: phone booth
Q: sea bass

A: booth for phones A: bass from the sea

Q: kitchen table Q: bass guitar

A: table for the kitchen

Q: steak knife

A: guitar for bass

A: knife for steak Q: bass fish

Q: grapefruit salt A: fish for bass

A: salt for grapefruit
Q: sea salt
Q: seawater fish

A: salt from the sea

A: fish from seawater

Noun compound interpretation

Q: ice cream

A: cream for ice

Q: machine gun

A: gun for machines

Q: broom stick

A: stick for broom

Q: chop sticks

A: sticks for chop

Q: fire arms

A: arms for fire

Q: fair use

A: use of fairness

Subject / Verb agreement:

Q: the keys to the cabinet are on the table

A: grammatical

Q: the key to the cabinet are on the table

A: non-grammatical

Q: the key to the cabinet is on the table

A: grammatical

Q: the keys to the cabinet is on the table

A: non-grammatical

Q: the boy who likes to wear blue shirts with white collars are smiling

A: grammatical

Q: the boy who likes to wear blue shirts with white collars is smiling

A: non-grammatical

Q: the boy is smiling

A: grammatical

Q: the boy are smiling

A: non-grammatical

Subject / Verb agreement:

Q: the keys to the cabinet are on the table

A: grammatical

Q: the key to the cabinet are on the table

A: non-grammatical

Q: the boy who likes to wear blue shirts with white collars are smiling

A: non-grammatical

Q: the boy who likes to wear blue shirts with white collars is smiling

A: grammatical

much better results on RCs --->

<--- Two more examples (with RC this time)

Q: the girls whom i met yesterday near the store is smiling

A: non-grammatical

Q: the girl I met yesterday near the stores that sell electronics is smiling

A: grammatical

Q: the girl I met yesterday near the stores that sell electronics are smiling

A: non-grammatical

Q: the girls on the hill near the boy is smiling

A: non-grammatical

Q: the girls on the hill near the boy are smiling

A: grammatical

Interim summary

- Impressive understanding of the form of language.
- Very very impressive ability to generalize to a task from a few examples.

Few more fun examples / GPT3 as memorizer / GPT3 as interpolator

```
def factorial(a):
                                                                                    def gcd(a, b):
                              if a == 0:
                                                                                    if b == 0:
                              return 1
                                                                                    return a
                              else:
                                                                                    else:
                              return a * factorial(a-1)
                                                                                    return gcd(b, a%b)
                              def fibonacci(n):
                                                                                    def is_prime(n):
                                                                                    if n <= 1:
                              if n < 2:
                                                                                    return False
                              return n
                                                                                    else:
                              else:
                                                                                    for i in range(2, n):
                              return fibonacci(n-1) + fibonacci(n-2)
                                                                                    if n
```

Few more fun examples / GPT3 as memorizer / GPT3 as interpolator

non recursive implementation of factorial def factorial(a):

```
# recursive implementation of factorial def factorial(a):
```

non recursive implementation of fibonacci def fibonacci(n):

recursive implementation of fibonacci def fibonacci(n):

non recursive implementation of fibonacci def fibonacci(n):

recursive implementation of fibonacci def fibonacci(n):

non recursive implementation of fibonacci def fibonacci(n):

recursive implementation of fibonacci def fibonacci(n):

non recursive implementation of fibonacci def fibonacci(n):

recursive implementation of fibonacci def fib

Few more fun examples / GPT3 as memorizer / GPT3 as interpolator

(defun factorial (n)

(defun (factorial b)

Playground



(defun (factorial b) (if (<= b 1) 1 (* b (factorial (- b 1)))))

The factorial function is a recursive function. It calls itself. The function factorial takes one argument, b, and returns the factorial of b. If b is less than or equal to 1, then the factorial of b is 1. Otherwise, the factorial of b is the product of b and the factorial of b minus 1.

The following example shows how to use the factorial function:

(factorial 5)

This expression evaluates to 120.

LispWorks User Guide and Reference Manual - 21 Dec 2011

The following python code:

```
def foo(a, b):

if a + b > 5: return 5

if a + b < -5: return b

return None
```

will be translated to java as:

```
public static int foo(int a, int b) { if (a + b > 5) { return 5; } if (a + b < -5) { return b; } return null; }
```

Note that the python code is translated to java, not compiled. This means that the resulting java code will be interpreted by the JVM, not compiled to native code.

The translation is done using the standard javac compiler. The generated java code is compatible with any java compiler.

The following python code:

```
def foo(a, b): if a + b > 5: return 5 if a + b < -5: return
```

```
The following python code:
def foo():
   a = 5
   for x in range(10):
     print(a)
   a = "a"
   for x in range(10):
      print(a)
will be translated to java as:
                         public static void main(String[] args) {
                                                                                      for (int x = 0; x < 10; x++) {
                                                                                                                       System.out.println(a);
                                                                                                                                                                                                   System.out.println(a);
                                                                                                                                                                  for (int x = 0; x < 10; x++) {
public class Foo {
                                                                      int a = 5;
                                                                                                                                                    a = "a";
The generated code is not as efficient as it could be, but it is a good starting point. The generated code is very similar to the code that would be written by a human programmer.
```

In addition to the code generation capabilities, javapackager also provides a GUI tool for creating and editing Java packages.

The following python code:

```
def foo():
    s = 0
    for x, y in zip(range(10), range(10)):
        s = s + x + y
    return s
```

will be translated to java as:

```
public class Foo { public int foo() { int s = 0; for (int x = 0; x < 10; x + +) { for (int y = 0; y < 10; y + +) { s = s + x + y; } return s; } }
```

This is a simple example, but it shows how the python code can be translated to java. The translation is not always this simple, but the idea is the same.

Py4J is a Python library that allows Python code to call Java code. Py4J is a bridge between Python and Java. Py4J is a Python library that allows Python code to call Java code. Py4J is a bridge between Python and Java.

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Ру

Few more f

```
nemorizer /
```

```
def verify_that_a_string_is_a_palindrome_of_length_k(s, k):
Verifies that a string is a palindrome of length k.
111111
if len(s) != k:
return False
for i in range(len(s)):
if s[i] != s[len(s) - i - 1]:
return False
return True
def verify_that_a_string_is_a_palindrome(s):
111111
Verifies that a string is a palindrome.
111111
return verify_that_a_string_is_a_palindrome_of_length_k(s, len(s))
def verify_that_a_string_is_not_a_palindrome(s):
111111
Verifies that a string is not a palindrome.
111111
return not verify_that_a_string_is_a_palindrome(s)
def verify_that_a_string_is_a_palindrome_of_length_n(s, n):
111111
Verifies that a string is a palindrome of length n.
```

```
the following python code

def foo(lst):
    return [x**2 for x in lst if x % 2 == 1]

can be written in java as:

public static List<Integer> foo(List<Integer> lst) {    return lst.stream().filter(x -> x % 2 == 1).map(x -> x * x); }
```

```
the following python code

def foo(lst):
    return [x**2 for x in lst if x % 2 == 1]

can be written in java as:

public static List<Integer> foo(List<Integer> lst) {    return lst.stream().filter(x -> x % 2 == 1).map(x -> x * x); }
```

```
the following python code

def foo(lst):
    return [x**5 for x in lst if x % 2 == 1]

can be written in java as:

public static List<Integer> foo(List<Integer> lst) {    return lst.stream().filter(x -> x % 2 == 1).map(x -> x * x * x * x * x * x).toList(); }
```

the following python code

def foo(lst):
 return [u for u in [x**5 for x in lst if x % 2 == 1] if u > 9]

can be written in java as:

public static List<Integer> foo(List<Integer> [st]) { return |st.stream().filter(x -> x.mod(2) == 1).map(x -> x.power(5)).filter(x -> x > 9).collect(Collectors.toList()); }

Until it breaks:

```
the following python code

def foo(lst):
    return [str(u) for u in [x**5 for x in lst if x % 2 == 1] if u > 9]

can be written in java as:

public static List<String> foo(List<Integer> lst) { return Arrays.asList(str(u) + "**5" + " if " + u % 2 == 1 + " else " + "0" + " > 9"); }
```

A haiku poem about muppets: When you see a muppet What do you see? A muppet. I wrote a haiku poem about riding in elevators: Waiting for the elevator In the building The elevator comes. I wrote a haiku poem about when I was in elementary school: My mom and dad Took me to school I cried. I wrote a haiku poem about when I was in junior high school: A school trip

We had fun.

To the science museum

A haiku poem about rain:

Red, yellow, red

Lightning in the rain

Birds fly away

The poem has three lines of five, seven, and five syllables, respectively. The first line contains three words with three syllables each, and the second line has two words with one syllable each. The third line contains four words with one syllable each.

The word "lightning" is the subject of the first line, and the word "rain" is the subject of the second line. The word "birds" is the subject of the third line.

The first line has two images, one about the color red and the other about lightning. The second line has one

A haiku poem about בית:

A haiku poem about בית:

חוצה לכל

מקום

בית

חוצה לכל

מקום

In English:

House

Shut out from all

A place

ורק אם יש בך את הבית שלך, אז תהייה מאושרת. בית המטבח שלך מושלם,

A haiku poem about בלונים:

מחזיק בלונים במטה העגל

בסדר ובנקודה

אני אוהב אותך, ידיד כל כך טוב.

This is the English translation:

Holder of balloons

on a goat's back

I love you so much, my friend.

(Source: haikupoem.com)

#6. "For You" by Nick Cave and the Bad Seeds