

# Training and updating models

ADVANCED NLP WITH SPACY



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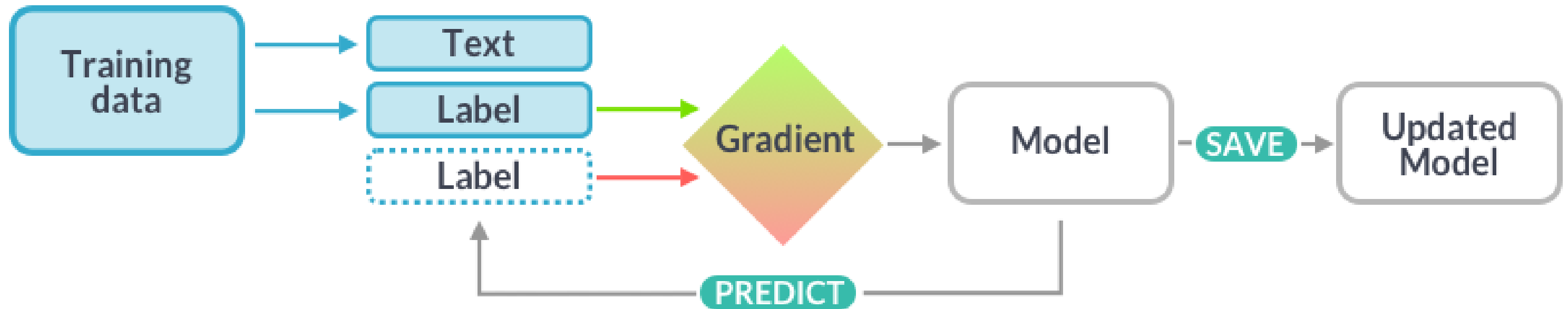
# Why updating the model?

- Better results on your specific domain
- Learn classification schemes specifically for your problem
- Essential for text classification
- Very useful for named entity recognition
- Less critical for part-of-speech tagging and dependency parsing

# How training works (1)

1. **Initialize** the model weights randomly with `nlp.begin_training`
2. **Predict** a few examples with the current weights by calling `nlp.update`
3. **Compare** prediction with true labels
4. **Calculate** how to change weights to improve predictions
5. **Update** weights slightly
6. Go back to 2.

# How training works (2)



- **Training data:** Examples and their annotations.
- **Text:** The input text the model should predict a label for.
- **Label:** The label the model should predict.
- **Gradient:** How to change the weights.

# Example: Training the entity recognizer

- The entity recognizer tags words and phrases in context
- Each token can only be part of one entity
- Examples need to come with context

```
("iPhone X is coming", {'entities': [(0, 8, 'GADGET')]}))
```

- Texts with no entities are also important

```
("I need a new phone! Any tips?", {'entities': []}))
```

- **Goal:** teach the model to generalize

# The training data

- Examples of what we want the model to predict in context
- Update an **existing model**: a few hundred to a few thousand examples
- Train a **new category**: a few thousand to a million examples
  - spaCy's English models: 2 million words
- Usually created manually by human annotators
- Can be semi-automated – for example, using spaCy's **Matcher** !

# Let's practice!

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# The training loop

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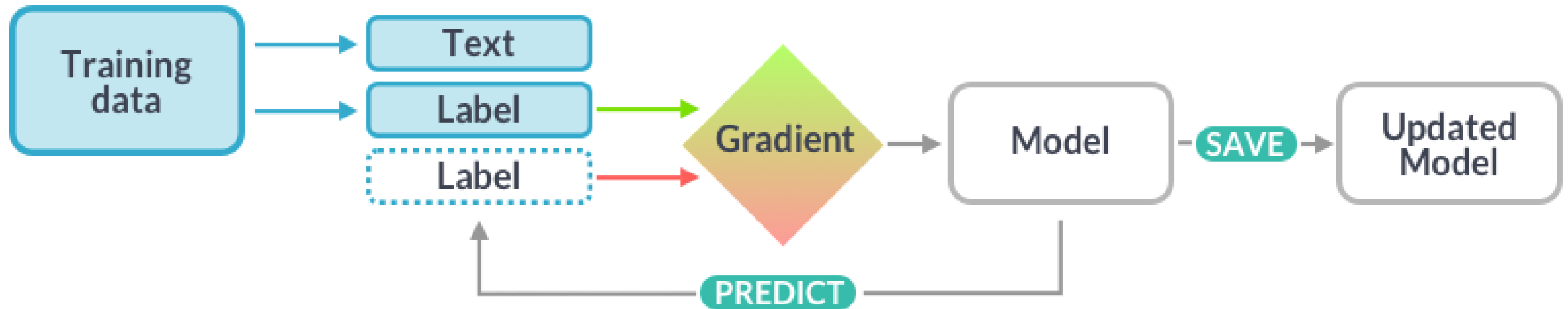
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# The steps of a training loop

1. **Loop** for a number of times.
2. **Shuffle** the training data.
3. **Divide** the data into batches.
4. **Update** the model for each batch.
5. **Save** the updated model.

# Recap: How training works



- **Training data:** Examples and their annotations.
- **Text:** The input text the model should predict a label for.
- **Label:** The label the model should predict.
- **Gradient:** How to change the weights.

# Example loop

```
TRAINING_DATA = [  
    ("How to preorder the iPhone X", {'entities': [(20, 28, 'GADGET')]}))  
    # And many more examples...  
]
```

```
# Loop for 10 iterations  
for i in range(10):  
    # Shuffle the training data  
    random.shuffle(TRAINING_DATA)  
    # Create batches and iterate over them  
    for batch in spacy.util.minibatch(TRAINING_DATA):  
        # Split the batch in texts and annotations  
        texts = [text for text, annotation in batch]  
        annotations = [annotation for text, annotation in batch]  
        # Update the model  
        nlp.update(texts, annotations)  
  
# Save the model  
nlp.to_disk(path_to_model)
```

# Updating an existing model

- Improve the predictions on new data
- Especially useful to improve existing categories, like PERSON
- Also possible to add new categories
- Be careful and make sure the model doesn't "forget" the old ones

# Setting up a new pipeline from scratch

```
# Start with blank English model
nlp = spacy.blank('en')

# Create blank entity recognizer and add it to the pipeline
ner = nlp.create_pipe('ner')
nlp.add_pipe(ner)

# Add a new label
ner.add_label('GADGET')

# Start the training
nlp.begin_training()

# Train for 10 iterations
for itn in range(10):
    random.shuffle(examples)

    # Divide examples into batches
    for batch in spacy.util.minibatch(examples, size=2):
        texts = [text for text, annotation in batch]
        annotations = [annotation for text, annotation in batch]

        # Update the model
        nlp.update(texts, annotations)
```

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# Best practices for training spaCy models

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# Problem 1: Models can "forget" things

- Existing model can overfit on new data
  - e.g.: if you only update it with `WEBSITE` , it can "unlearn" what a `PERSON` is
- Also known as "catastrophic forgetting" problem



# Solution 1: Mix in previously correct predictions

- For example, if you're training `WEBSITE`, also include examples of `PERSON`
- Run existing spaCy model over data and extract all other relevant entities

**BAD:**

```
TRAINING_DATA = [  
    ('Reddit is a website', {'entities': [(0, 6, 'WEBSITE')]}))  
]
```

**GOOD:**

```
TRAINING_DATA = [  
    ('Reddit is a website', {'entities': [(0, 6, 'WEBSITE')]})),  
    ('Obama is a person', {'entities': [(0, 5, 'PERSON')]}))  
]
```

# Problem 2: Models can't learn everything

- spaCy's models make predictions based on **local context**
- Model can struggle to learn if decision is difficult to make based on context
- Label scheme needs to be consistent and not too specific
  - For example: **CLOTHING** is better than **ADULT\_CLOTHING** and **CHILDRENS\_CLOTHING**

# Solution 2: Plan your label scheme carefully

- Pick categories that are reflected in local context
- More generic is better than too specific
- Use rules to go from generic labels to specific categories

**BAD:**

```
LABELS = [ 'ADULT_SHOES' , 'CHILDRENS_SHOES' , 'BANDS_I_LIKE' ]
```

**GOOD:**

```
LABELS = [ 'CLOTHING' , 'BAND' ]
```

# Let's practice!

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# Wrapping up

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# Your new spaCy skills

- Extract **linguistic features**: part-of-speech tags, dependencies, named entities
- Work with pre-trained **statistical models**
- Find words and phrases using `Matcher` and `PhraseMatcher` **match rules**
- Best practices for working with **data structures** `Doc` , `Token` `Span` , `Vocab` , `Lexeme`
- Find **semantic similarities** using **word vectors**
- Write custom **pipeline components** with **extension attributes**
- **Scale up** your spaCy pipelines and make them fast
- Create **training data** for spaCy's statistical models
- **Train and update** spaCy's neural network models with new data

# More things to do with spaCy (1)

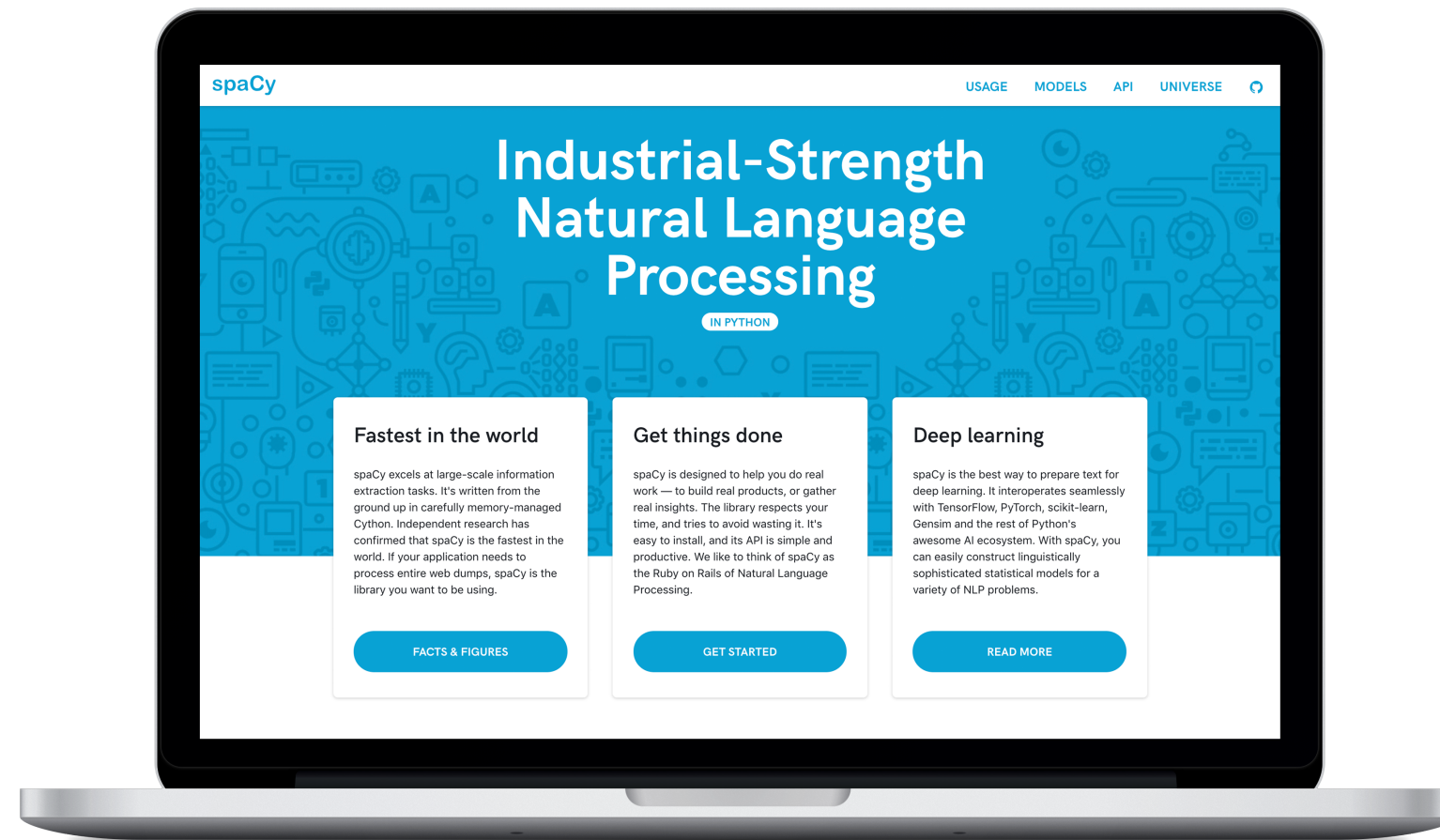
- **Training and updating** other pipeline components
  - Part-of-speech tagger
  - Dependency parser
  - Text classifier

# More things to do with spaCy (2)

- **Customizing the tokenizer**
  - Adding rules and exceptions to split text differently
- **Adding or improving support for other languages**
  - 45+ languages currently
  - Lots of room for improvement and more languages
  - Allows training models for other languages



# See the website for more info and documentation!



spacy.io

**Thanks and see you  
soon!**

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