# Structured Neural Summarization

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Deep Program Understanding
https://aka.ms/msrc-dpu

## Overview

**Task:** Reason about weakly structured sequences.

**Idea:** Extend traditional sequence encoders with a graph neural network component.

**Evaluation:** Source code and natural language summarization tasks.

Code available at:

## Code Summarization

**Method Naming:** infer the name of the function given the body

**Method Documentation:** infer a succinct natural language description given the function

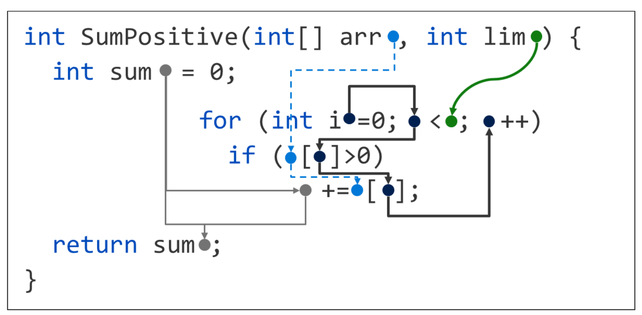
```
int sum = 0;
for (int i = 0; i < lim; i++)
  if (arr[i]>0)
      sum += arr[i];

return sum;
```

*Method Name:*
SumPositive

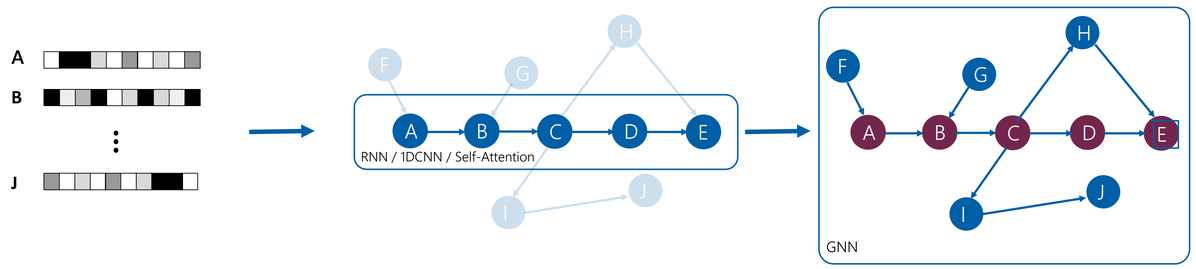
*Method Documentation:*
Returns the sum of the positive numbers in an array

We add syntactic and semantic information using edges between tokens

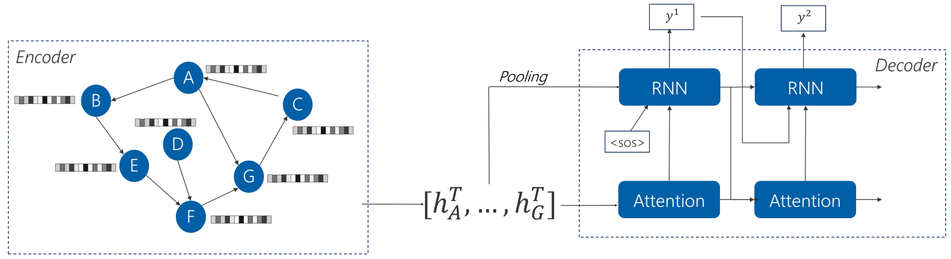



## Sequence GNNs and Summarization Model

Idea: Compose sequence encoder on the main sequence with a graph encoder on the full structure




Sequenced graph encoder is drop-in replacement for existing sequence encoders:

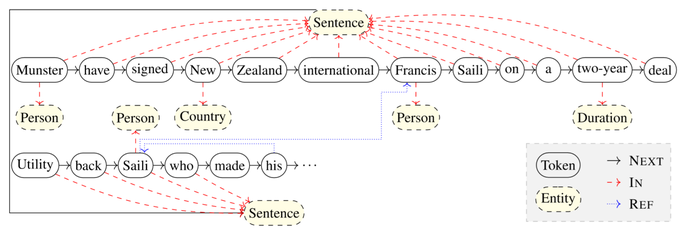



## Text Summarization

We consider the task of *abstractive summarization*

*Alice and Bob took the train to visit the zoo. They saw a baby giraffe, a lion, and a flock of colorful tropical birds.* → *Alice and Bob visited the zoo and saw animals and birds.*

We include information from linguistic analysis tools as edges between tokens




## Evaluation

Our approach produces state-of-art results on code summarization tasks

| C# Documentation | F1 | ROUGE-2 | ROUGE-L |
|---|---|---|---|
| RNN -> RNN | 35.2 | 20.8 | 36.7 |
| GNN -> RNN | 38.9 | 25.6 | 37.1 |
| RNN + GNN -> RNN | **45.4** | **28.3** | **41.1** |

| Java Method Naming | F1 | ROUGE-2 | ROUGE-L |
|---|---|---|---|
| Alon et al. | 43.0 | - | - |
| RNN -> RNN | 35.8 | 17.9 | 39.7 |
| RNN + GNN -> RNN | **44.7** | **21.1** | 43.1 |
| SelfAtt -> SelfAtt | 24.9 | 8.3 | 27.4 |
| SeflAtt + GNN -> SelfAtt | 44.5 | 20.9 | **43.4** |

Outperforms comparable models with sequence encoders on natural language summarization

| CNN/DailyMail | ROUGE-1 | ROUGE-2 | ROUGE-L |
|---|---|---|---|
| RNN -> RNN | 31.3 | 11.8 | 28.8 |
| RNN + GNN -> RNN | 33.0 | 13.3 | 28.3 |
| RNN -> RNN + pointer | 36.4 | 15.7 | **33.4** |
| RNN + GNN -> RNN + pointer | **38.1** | **16.1** | 33.2 |