

## 1 ADDITIONAL RESULTS

Table 1: Effects of code preprocessing pipelines with fine-tuned embeddings.

Model	Pipeline	MRR	Acc@1	Acc@5	Acc@10
Bi-LSTM	Tokenize	0.23 (0.01)	0.13 (0.01)	0.33 (0.01)	0.46 (0.01)
	Tokenize + method name&calls	0.21 (0.01)	0.11 (0.01)	0.30 (0.01)	0.42 (0.01)
	<b>Tokenize + remove stop words</b>	<b>0.25 (0.01)</b>	<b>0.14 (0.01)</b>	<b>0.35 (0.01)</b>	<b>0.46 (0.01)</b>
	Tokenize + remove stop words + stem	0.23 (0.01)	0.13 (0.01)	0.32 (0.01)	0.45 (0.01)
DAN	Tokenize	0.17 (0.01)	0.09 (0.01)	0.23 (0.02)	0.34 (0.01)
	Tokenize + method name&calls	0.15 (0.01)	0.07 (0.01)	0.21 (0.01)	0.32 (0.02)
	Tokenize + remove stop words	0.17 (0.01)	0.08 (0.01)	0.24 (0.02)	0.35 (0.01)
	Tokenize + remove stop words + stem	0.16 (0.01)	0.08 (0.01)	0.24 (0.01)	0.35 (0.01)

(a) CONALA-Test

Model	Pipeline	MRR	Acc@1	Acc@5	Acc@10
Bi-LSTM	Tokenize	0.64 (0.01)	0.53 (0.02)	0.76 (0.01)	0.83 (0.01)
	Tokenize + method name&calls	0.43 (0.01)	0.32 (0.01)	0.53 (0.01)	0.63 (0.01)
	<b>Tokenize + remove stop words</b>	<b>0.64 (0.01)</b>	<b>0.54 (0.01)</b>	<b>0.77 (0.01)</b>	<b>0.84 (0.01)</b>
	Tokenize + remove stop words + stem	0.60 (0.01)	0.49 (0.02)	0.73 (0.01)	0.81 (0.01)
DAN	Tokenize	0.44 (0.01)	0.32 (0.01)	0.58 (0.01)	0.68 (0.01)
	Tokenize + method name&calls	0.28 (0.01)	0.17 (0.01)	0.39 (0.01)	0.49 (0.01)
	Tokenize + remove stop words	0.44 (0.02)	0.31 (0.02)	0.57 (0.02)	0.67 (0.02)
	Tokenize + remove stop words + stem	0.41 (0.02)	0.29 (0.02)	0.55 (0.02)	0.66 (0.02)

(b) GitHub-Test

**Table 2: Effects of NL preprocessing pipelines with fine-tuned embeddings.**

Model	Pipeline	MRR	Acc@1	Acc@5	Acc@10
Bi-LSTM	Tokenize	0.24 (0.01)	0.15 (0.00)	0.34 (0.01)	0.46 (0.02)
	Tokenize + remove param&return	0.24 (0.01)	0.14 (0.01)	0.32 (0.01)	0.44 (0.01)
	Tokenize + first sentence	0.23 (0.01)	0.13 (0.01)	0.32 (0.01)	0.43 (0.01)
	Tokenize + remove stop words	0.25 (0.01)	0.15 (0.01)	0.35 (0.01)	0.47 (0.01)
	Tokenize + remove stop words + stem	0.24 (0.01)	0.14 (0.01)	0.33 (0.01)	0.45 (0.01)
DAN	Tokenize	0.18 (0.02)	0.09 (0.02)	0.24 (0.02)	0.35 (0.02)
	Tokenize + remove param&return	0.17 (0.01)	0.09 (0.01)	0.24 (0.01)	0.35 (0.02)
	Tokenize + first sentence	0.16 (0.01)	0.08 (0.01)	0.22 (0.01)	0.33 (0.01)
	Tokenize + remove stop words	0.19 (0.01)	0.10 (0.01)	0.26 (0.01)	0.38 (0.01)
	Tokenize + remove stop words + stem	0.18 (0.01)	0.09 (0.01)	0.25 (0.01)	0.36 (0.01)
(a) <i>CONALA-Test</i>					
Model	Pipeline	MRR	Acc@1	Acc@5	Acc@10
Bi-LSTM	Tokenize	0.64 (0.01)	0.54 (0.02)	0.76 (0.01)	0.83 (0.01)
	Tokenize + remove param&return	0.64 (0.01)	0.53 (0.02)	0.77 (0.01)	0.83 (0.01)
	Tokenize + first sentence	0.63 (0.01)	0.53 (0.01)	0.75 (0.01)	0.82 (0.01)
	Tokenize + remove stop words	0.65 (0.00)	0.55 (0.01)	0.77 (0.01)	0.84 (0.01)
	Tokenize + remove stop words + stem	0.61 (0.01)	0.50 (0.02)	0.75 (0.01)	0.82 (0.01)
DAN	Tokenize	0.43 (0.01)	0.31 (0.01)	0.58 (0.01)	0.69 (0.01)
	Tokenize + remove param&return	0.44 (0.01)	0.32 (0.01)	0.58 (0.02)	0.69 (0.01)
	Tokenize + first sentence	0.42 (0.01)	0.29 (0.01)	0.57 (0.01)	0.67 (0.01)
	Tokenize + remove stop words	0.46 (0.01)	0.34 (0.01)	0.61 (0.01)	0.70 (0.01)
	Tokenize + remove stop words + stem	0.43 (0.02)	0.31 (0.02)	0.58 (0.02)	0.69 (0.02)
(b) <i>GitHub-Test</i>					

**Table 3: Effects of code preprocessing pipelines with additional DAN models.**

Model	Pipeline	MRR	Acc@1	Acc@5	Acc@10
DAN-deep	Tokenize	0.13 (0.01)	0.06 (0.01)	0.19 (0.01)	0.29 (0.01)
	Tokenize + method name&calls	0.12 (0.01)	0.05 (0.01)	0.16 (0.02)	0.25 (0.02)
	Tokenize + remove stop words	0.14 (0.01)	0.06 (0.01)	0.19 (0.01)	0.29 (0.02)
	Tokenize + remove stop words + stem	0.12 (0.01)	0.05 (0.00)	0.16 (0.02)	0.25 (0.02)
DAN-wide	Tokenize	0.17 (0.01)	0.09 (0.01)	0.24 (0.02)	0.34 (0.02)
	Tokenize + method name&calls	0.16 (0.01)	0.07 (0.01)	0.23 (0.01)	0.34 (0.01)
	Tokenize + remove stop words	0.17 (0.01)	0.08 (0.01)	0.25 (0.02)	0.36 (0.02)
	Tokenize + remove stop words + stem	0.17 (0.01)	0.08 (0.01)	0.23 (0.01)	0.34 (0.02)
(a) <i>CONALA-Test</i>					
Model	Pipeline	MRR	Acc@1	Acc@5	Acc@10
DAN-deep	Tokenize	0.30 (0.01)	0.18 (0.01)	0.43 (0.02)	0.56 (0.02)
	Tokenize + method name&calls	0.19 (0.01)	0.09 (0.01)	0.26 (0.02)	0.38 (0.02)
	Tokenize + remove stop words	0.30 (0.02)	0.18 (0.03)	0.42 (0.03)	0.56 (0.03)
	Tokenize + remove stop words + stem	0.23 (0.02)	0.12 (0.02)	0.35 (0.03)	0.47 (0.03)
DAN-wide	Tokenize	0.44 (0.02)	0.32 (0.02)	0.58 (0.02)	0.69 (0.02)
	Tokenize + method name&calls	0.30 (0.01)	0.19 (0.02)	0.41 (0.01)	0.52 (0.01)
	Tokenize + remove stop words	0.44 (0.02)	0.32 (0.02)	0.58 (0.02)	0.68 (0.02)
	Tokenize + remove stop words + stem	0.38 (0.03)	0.26 (0.03)	0.52 (0.03)	0.64 (0.03)
(b) <i>GitHub-Test</i>					

**Table 4: Effects of NL preprocessing pipelines with additional DAN models.**

Model	Pipeline	MRR	Acc@1	Acc@5	Acc@10
DAN-deep	Tokenize	0.14 (0.01)	0.06 (0.00)	0.19 (0.01)	0.29 (0.01)
	Tokenize + remove param&return	0.13 (0.01)	0.05 (0.01)	0.18 (0.01)	0.27 (0.01)
	Tokenize + first sentence	0.12 (0.01)	0.05 (0.01)	0.16 (0.02)	0.26 (0.02)
	Tokenize + remove stop words	0.15 (0.01)	0.07 (0.01)	0.22 (0.01)	0.33 (0.01)
	Tokenize + remove stop words + stem	0.14 (0.01)	0.06 (0.01)	0.19 (0.01)	0.30 (0.02)
DAN-wide	Tokenize	0.17 (0.01)	0.09 (0.01)	0.24 (0.02)	0.36 (0.02)
	Tokenize + remove param&return	0.17 (0.01)	0.09 (0.01)	0.24 (0.01)	0.35 (0.01)
	Tokenize + first sentence	0.16 (0.01)	0.07 (0.01)	0.23 (0.01)	0.33 (0.02)
	Tokenize + remove stop words	0.19 (0.01)	0.10 (0.01)	0.27 (0.01)	0.39 (0.01)
	Tokenize + remove stop words + stem	0.18 (0.01)	0.09 (0.01)	0.25 (0.02)	0.36 (0.02)
(a) <i>CONALA-Test</i>					
Model	Pipeline	MRR	Acc@1	Acc@5	Acc@10
DAN-deep	Tokenize	0.31 (0.02)	0.19 (0.02)	0.43 (0.01)	0.55 (0.02)
	Tokenize + remove param&return	0.29 (0.03)	0.17 (0.02)	0.42 (0.03)	0.54 (0.03)
	Tokenize + first sentence	0.29 (0.01)	0.18 (0.01)	0.41 (0.01)	0.55 (0.02)
	Tokenize + remove stop words	0.35 (0.01)	0.22 (0.01)	0.48 (0.02)	0.60 (0.01)
	Tokenize + remove stop words + stem	0.30 (0.01)	0.18 (0.01)	0.43 (0.02)	0.56 (0.02)
DAN-wide	Tokenize	0.42 (0.02)	0.30 (0.02)	0.56 (0.02)	0.67 (0.02)
	Tokenize + remove param&return	0.44 (0.02)	0.31 (0.02)	0.57 (0.02)	0.68 (0.02)
	Tokenize + first sentence	0.43 (0.01)	0.31 (0.01)	0.56 (0.02)	0.67 (0.01)
	Tokenize + remove stop words	0.47 (0.02)	0.35 (0.03)	0.61 (0.01)	0.70 (0.02)
	Tokenize + remove stop words + stem	0.44 (0.02)	0.32 (0.02)	0.58 (0.01)	0.69 (0.01)
(b) <i>GitHub-Test</i>					

**Table 5: Effects of vocabulary size, extended results.**

Model	Minimum token frequency	MRR	Acc@1	Acc@5	Acc@10
Bi-LSTM	1	0.24 (0.01)	0.15 (0.00)	0.33 (0.01)	0.45 (0.02)
	10	0.25 (0.01)	0.15 (0.01)	0.34 (0.01)	0.46 (0.01)
	15	0.24 (0.01)	0.14 (0.01)	0.33 (0.02)	0.46 (0.01)
	20	0.25 (0.01)	0.15 (0.01)	0.34 (0.01)	0.47 (0.01)
	100	0.24 (0.01)	0.14 (0.01)	0.34 (0.01)	0.46 (0.02)
	1000	0.22 (0.01)	0.13 (0.01)	0.31 (0.02)	0.42 (0.01)
	10000	0.16 (0.01)	0.07 (0.01)	0.22 (0.01)	0.34 (0.01)
DAN	1	0.21 (0.01)	0.11 (0.01)	0.29 (0.01)	0.40 (0.02)
	10	0.20 (0.01)	0.11 (0.01)	0.28 (0.02)	0.39 (0.01)
	15	0.20 (0.01)	0.11 (0.01)	0.27 (0.01)	0.39 (0.01)
	20	0.20 (0.01)	0.10 (0.01)	0.27 (0.02)	0.39 (0.02)
	100	0.19 (0.00)	0.10 (0.00)	0.27 (0.01)	0.38 (0.01)
	1000	0.17 (0.01)	0.08 (0.01)	0.23 (0.01)	0.35 (0.01)
	10000	0.09 (0.00)	0.03 (0.00)	0.13 (0.01)	0.21 (0.01)
(a) <i>CONALA-Test</i>					
Model	Minimum token frequency	MRR	Acc@1	Acc@5	Acc@10
Bi-LSTM	1	0.65 (0.01)	0.56 (0.01)	0.77 (0.01)	0.84 (0.01)
	10	0.67 (0.01)	0.57 (0.01)	0.79 (0.01)	0.86 (0.01)
	15	0.65 (0.02)	0.55 (0.02)	0.77 (0.01)	0.84 (0.01)
	20	0.65 (0.02)	0.55 (0.02)	0.77 (0.01)	0.84 (0.01)
	100	0.64 (0.02)	0.54 (0.02)	0.75 (0.02)	0.82 (0.01)
	1000	0.57 (0.02)	0.47 (0.02)	0.70 (0.02)	0.77 (0.01)
	10000	0.43 (0.01)	0.33 (0.01)	0.55 (0.01)	0.64 (0.02)
DAN	1	0.51 (0.01)	0.39 (0.01)	0.64 (0.01)	0.73 (0.01)
	10	0.50 (0.02)	0.38 (0.02)	0.63 (0.02)	0.72 (0.02)
	15	0.50 (0.02)	0.38 (0.02)	0.64 (0.02)	0.74 (0.01)
	20	0.49 (0.02)	0.38 (0.02)	0.63 (0.02)	0.72 (0.01)
	100	0.44 (0.01)	0.32 (0.02)	0.58 (0.02)	0.68 (0.01)
	1000	0.40 (0.01)	0.28 (0.01)	0.52 (0.02)	0.62 (0.01)
	10000	0.22 (0.01)	0.12 (0.01)	0.31 (0.02)	0.42 (0.02)
(b) <i>GitHub-Test</i>					