

Unsupervised Social Network Embedding via Adaptive Specific Mappings

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Problems & Ideas

- **Problem:** Given a social network $G = (V, E, X)$, the purpose of our problem is to represent each node v as a low-dimensional vector z by learning a mapping function f .
- **Ideas:** We propose ASM mainly consists of encoder and decoder. The non-linear property of node attributes and network structure are captured using the kernel mapping in encoder, and the attention layer is used to fuse them. In decoder, ASM uses a reconstruction approach to learn node properties and network structure during training.

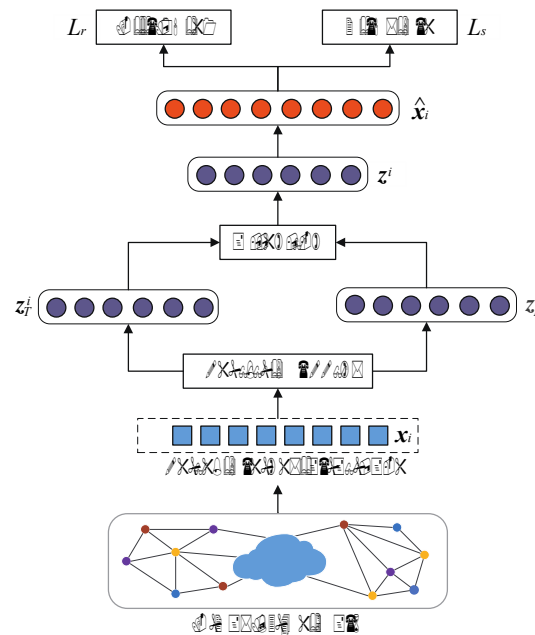


Fig.1. The architecture of our method

Main Contributions

- Contributions: The experimental results show that our method achieves better network representations and performance gains in node classification and node clustering in comparison with state-of-the-art baselines. Besides, the experimental results verify the efficiency of our method.

Table 1 Node classification results.

| Datasets | Metrics | LN | AE | DeepWalk | N2V | UPP-SNE | ANRL | DANE | CFANE | AM-GCN | ASM |
|--------------|----------|----|-------|----------|-------|---------|-------|-------|-------|--------|--------------|
| Face-book | Macro-F1 | 10 | 0.742 | 0.481 | 0.407 | 0.819 | 0.434 | 0.725 | 0.805 | 0.852 | 0.886 |
| | | 30 | 0.844 | 0.506 | 0.460 | 0.820 | 0.437 | 0.776 | 0.834 | 0.854 | 0.892 |
| | | 50 | 0.858 | 0.543 | 0.470 | 0.823 | 0.439 | 0.803 | 0.852 | 0.863 | 0.901 |
| | Micro-F1 | 10 | 0.832 | 0.623 | 0.620 | 0.891 | 0.755 | 0.804 | 0.881 | 0.902 | 0.923 |
| | | 30 | 0.890 | 0.698 | 0.775 | 0.892 | 0.757 | 0.839 | 0.904 | 0.905 | 0.931 |
| | | 50 | 0.903 | 0.722 | 0.782 | 0.894 | 0.777 | 0.865 | 0.909 | 0.911 | 0.937 |
| Google | Macro-F1 | 10 | 0.775 | 0.511 | 0.358 | 0.625 | 0.883 | 0.747 | 0.786 | 0.802 | 0.890 |
| | | 30 | 0.843 | 0.536 | 0.370 | 0.648 | 0.886 | 0.792 | 0.883 | 0.809 | 0.892 |
| | | 50 | 0.867 | 0.562 | 0.389 | 0.662 | 0.887 | 0.813 | 0.844 | 0.821 | 0.894 |
| | Micro-F1 | 10 | 0.804 | 0.532 | 0.537 | 0.657 | 0.897 | 0.831 | 0.809 | 0.811 | 0.902 |
| | | 30 | 0.855 | 0.584 | 0.553 | 0.627 | 0.900 | 0.869 | 0.849 | 0.825 | 0.903 |
| | | 50 | 0.885 | 0.606 | 0.585 | 0.700 | 0.901 | 0.887 | 0.866 | 0.829 | 0.903 |
| Twitter | Macro-F1 | 10 | 0.688 | 0.531 | 0.367 | 0.578 | 0.563 | 0.543 | 0.578 | 0.742 | 0.793 |
| | | 30 | 0.722 | 0.546 | 0.372 | 0.655 | 0.693 | 0.589 | 0.602 | 0.762 | 0.807 |
| | | 50 | 0.760 | 0.561 | 0.393 | 0.672 | 0.705 | 0.641 | 0.650 | 0.776 | 0.821 |
| | Micro-F1 | 10 | 0.705 | 0.544 | 0.493 | 0.609 | 0.622 | 0.652 | 0.612 | 0.751 | 0.796 |
| | | 30 | 0.730 | 0.553 | 0.503 | 0.658 | 0.701 | 0.671 | 0.623 | 0.768 | 0.805 |
| | | 50 | 0.765 | 0.566 | 0.524 | 0.674 | 0.711 | 0.701 | 0.659 | 0.779 | 0.819 |
| Citeseer | Macro-F1 | 10 | 0.594 | 0.442 | 0.489 | 0.552 | 0.660 | 0.605 | 0.663 | 0.659 | 0.687 |
| | | 30 | 0.633 | 0.505 | 0.503 | 0.569 | 0.679 | 0.649 | 0.687 | 0.682 | 0.694 |
| | | 50 | 0.649 | 0.513 | 0.511 | 0.586 | 0.688 | 0.660 | 0.700 | 0.697 | 0.705 |
| | Micro-F1 | 10 | 0.644 | 0.482 | 0.537 | 0.614 | 0.717 | 0.673 | 0.710 | 0.688 | 0.734 |
| | | 30 | 0.680 | 0.555 | 0.569 | 0.631 | 0.724 | 0.716 | 0.725 | 0.708 | 0.738 |
| | | 50 | 0.696 | 0.575 | 0.593 | 0.669 | 0.739 | 0.753 | 0.728 | 0.716 | 0.740 |
| Blog-Catalog | Macro-F1 | 10 | 0.853 | 0.261 | 0.662 | 0.250 | 0.538 | 0.762 | 0.859 | 0.754 | 0.904 |
| | | 30 | 0.868 | 0.265 | 0.692 | 0.297 | 0.558 | 0.787 | 0.873 | 0.822 | 0.922 |
| | | 50 | 0.871 | 0.271 | 0.702 | 0.308 | 0.564 | 0.812 | 0.881 | 0.852 | 0.925 |
| | Micro-F1 | 10 | 0.859 | 0.263 | 0.601 | 0.253 | 0.633 | 0.815 | 0.901 | 0.763 | 0.904 |
| | | 30 | 0.870 | 0.268 | 0.638 | 0.303 | 0.646 | 0.870 | 0.915 | 0.829 | 0.923 |
| | | 50 | 0.876 | 0.274 | 0.665 | 0.315 | 0.648 | 0.897 | 0.922 | 0.855 | 0.929 |
| Flickr | Macro-F1 | 10 | 0.505 | 0.201 | 0.312 | 0.641 | 0.703 | 0.687 | 0.751 | 0.713 | 0.758 |
| | | 30 | 0.536 | 0.245 | 0.355 | 0.683 | 0.718 | 0.692 | 0.779 | 0.749 | 0.783 |
| | | 50 | 0.572 | 0.262 | 0.361 | 0.705 | 0.734 | 0.717 | 0.793 | 0.787 | 0.797 |
| | Micro-F1 | 10 | 0.522 | 0.209 | 0.322 | 0.651 | 0.721 | 0.702 | 0.764 | 0.735 | 0.769 |
| | | 30 | 0.578 | 0.251 | 0.368 | 0.698 | 0.740 | 0.729 | 0.786 | 0.766 | 0.799 |
| | | 50 | 0.596 | 0.269 | 0.374 | 0.718 | 0.758 | 0.745 | 0.802 | 0.793 | 0.804 |
| Cora | Macro-F1 | 10 | 0.412 | 0.256 | 0.221 | 0.250 | 0.421 | 0.509 | 0.575 | 0.533 | 0.556 |
| | | 30 | 0.433 | 0.292 | 0.277 | 0.297 | 0.459 | 0.524 | 0.603 | 0.579 | 0.587 |
| | | 50 | 0.462 | 0.343 | 0.334 | 0.308 | 0.488 | 0.545 | 0.619 | 0.608 | 0.613 |
| | Micro-F1 | 10 | 0.422 | 0.259 | 0.235 | 0.253 | 0.445 | 0.511 | 0.572 | 0.542 | 0.564 |
| | | 30 | 0.439 | 0.298 | 0.289 | 0.303 | 0.472 | 0.534 | 0.602 | 0.588 | 0.592 |
| | | 50 | 0.477 | 0.351 | 0.340 | 0.315 | 0.502 | 0.563 | 0.625 | 0.620 | 0.615 |

Table 2 Node clustering results.

| Model | Facebook | Google | Twitter | Citeseer | BlogCatalog | Flickr | Cora |
|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Autoencoder | 0.518 | 0.733 | 0.716 | 0.687 | 0.294 | 0.512 | 0.539 |
| DeepWalk | 0.541 | 0.550 | 0.529 | 0.423 | 0.192 | 0.298 | 0.401 |
| Node2vec | 0.600 | 0.543 | 0.551 | 0.456 | 0.368 | 0.323 | 0.438 |
| UPP-SNE | 0.896 | 0.639 | 0.581 | 0.678 | 0.228 | 0.421 | 0.451 |
| ANRL | 0.566 | 0.637 | 0.588 | 0.692 | 0.593 | 0.523 | 0.447 |
| DANE | 0.501 | 0.497 | 0.611 | 0.591 | 0.533 | 0.504 | 0.487 |
| CFANE | 0.520 | 0.507 | 0.647 | 0.877 | 0.884 | 0.773 | 0.683 |
| AM-GCN | 0.818 | 0.797 | 0.736 | 0.865 | 0.716 | 0.745 | 0.712 |
| ASM | 0.631 | 0.817 | 0.805 | 0.882 | 0.549 | 0.711 | 0.691 |

Table 3 Runtime on the datasets.

| Datasets | ANRL | CFANE | AM-GCN | ASM |
|-------------|-------|--------|--------|------|
| Facebook | 242 | 3,325 | 15 | 106 |
| Google | 304 | 5,418 | 20 | 132 |
| Twitter | 221 | 2,986 | 13 | 93 |
| Citeseer | 621 | 7,486 | 23 | 330 |
| BlogCatalog | 884 | 9,075 | 35 | 391 |
| Flickr | 1345 | 15,742 | 62 | 719 |
| Cora | 3,216 | 6,198 | 231 | 1494 |