

A knowledge graph on FHIR

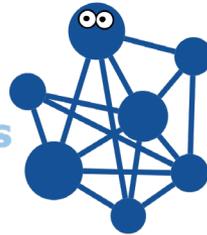
The MeDaX  pipeline

Ilya Mazein, Tom Gebhardt, Felix Zinkewitz,
Lea Michaelis, Sarah Braun, Dagmar Waltemath,
Ron Henkel and Judith A.H. Wodke



Ilya Mazein

Medical
Informatics
LABoratory

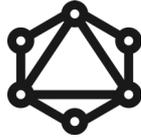


Judith Wodke





Clinical data



Graph models



Structure



Enrichment



Exploration





- Format
- Structure
- File



www.hl7.org/fhir/patient.html

```

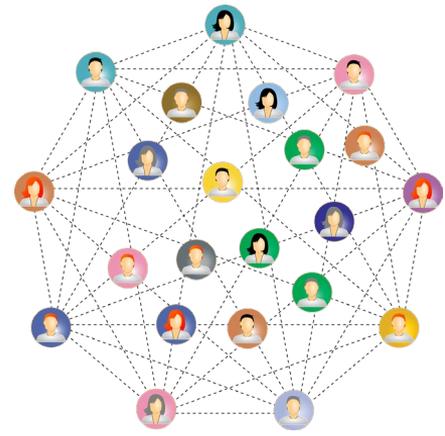
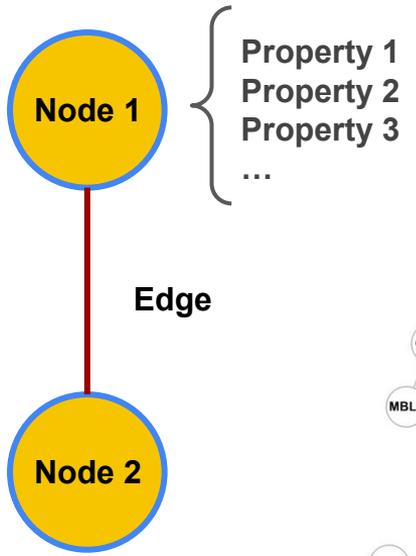
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  identifier {
    type {
      value
    }
    value
  }
  active
  name {
    family
    given
    middle
    prefix
    suffix
  }
  telecom {
    telephone
    fax
    email
    pager
  }
  gender
  birthDate
  deceased {
    value
  }
  address {
    use
    type
    text
    line
    city
    state
    postalCode
    country
  }
  maritalStatus
  multipleBirth {
    value
  }
  photo {
    url
  }
  contact {
    name
    relationship
    address
    telephone
    fax
    email
    pager
  }
  communication {
    name
    address
    telephone
    fax
    email
    pager
  }
  generalPractitioner {
    name
    address
    telephone
    fax
    email
    pager
  }
  managingOrganization {
    name
    address
    telephone
    fax
    email
    pager
  }
  link {
    url
  }
}

```

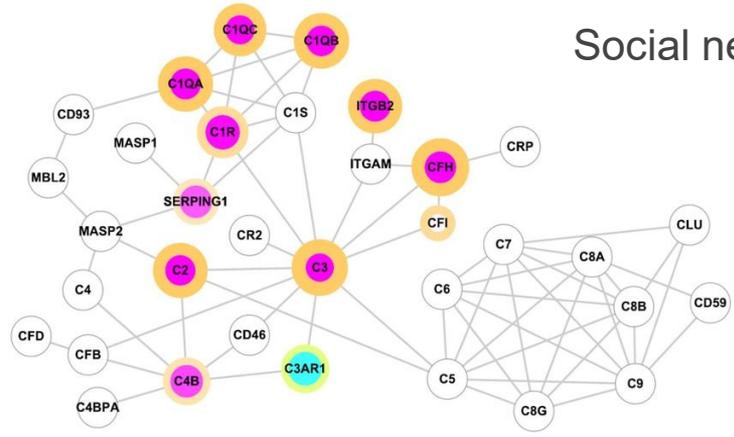




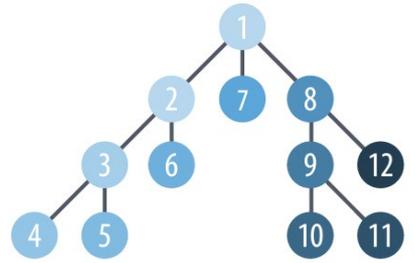
Graph databases



Social networks



Protein interactions



Traversal algorithms



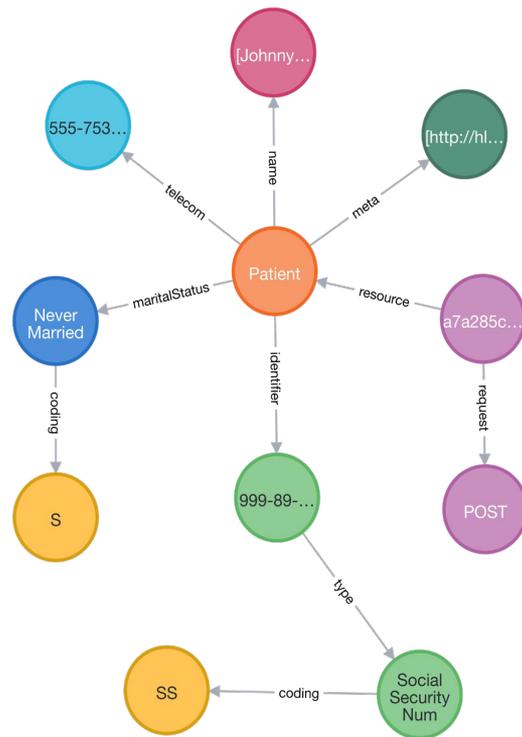


```

"entry": [ {
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    "resourceType": "Patient",
    "id": "a7a285c0-4714-dd3c-4837-8719c9b67873",
    "meta": {
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    },
    "identifier": [ {
      "type": {
        "coding": [ {
          "system": "http://terminology.hl7.org/CodeSystem/v2-0203",
          "code": "SS",
          "display": "Social Security Number"
        } ],
        "text": "Social Security Number"
      },
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      "value": "999-89-9526"
    } ],
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      "given": [ "Johnny786", "Vince741" ]
    } ],
    "telecom": [ {
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      "value": "555-753-6560",
      "use": "home"
    } ],
    "gender": "male",
    "birthDate": "2021-05-22",
    "maritalStatus": {
      "coding": [ {
        "system": "http://terminology.hl7.org/CodeSystem/v3-MaritalStatus",
        "code": "S",
        "display": "Never Married"
      } ],
      "text": "Never Married"
    }
  },
  "request": {
    "method": "POST",
    "url": "Patient"
  }
} ]

```

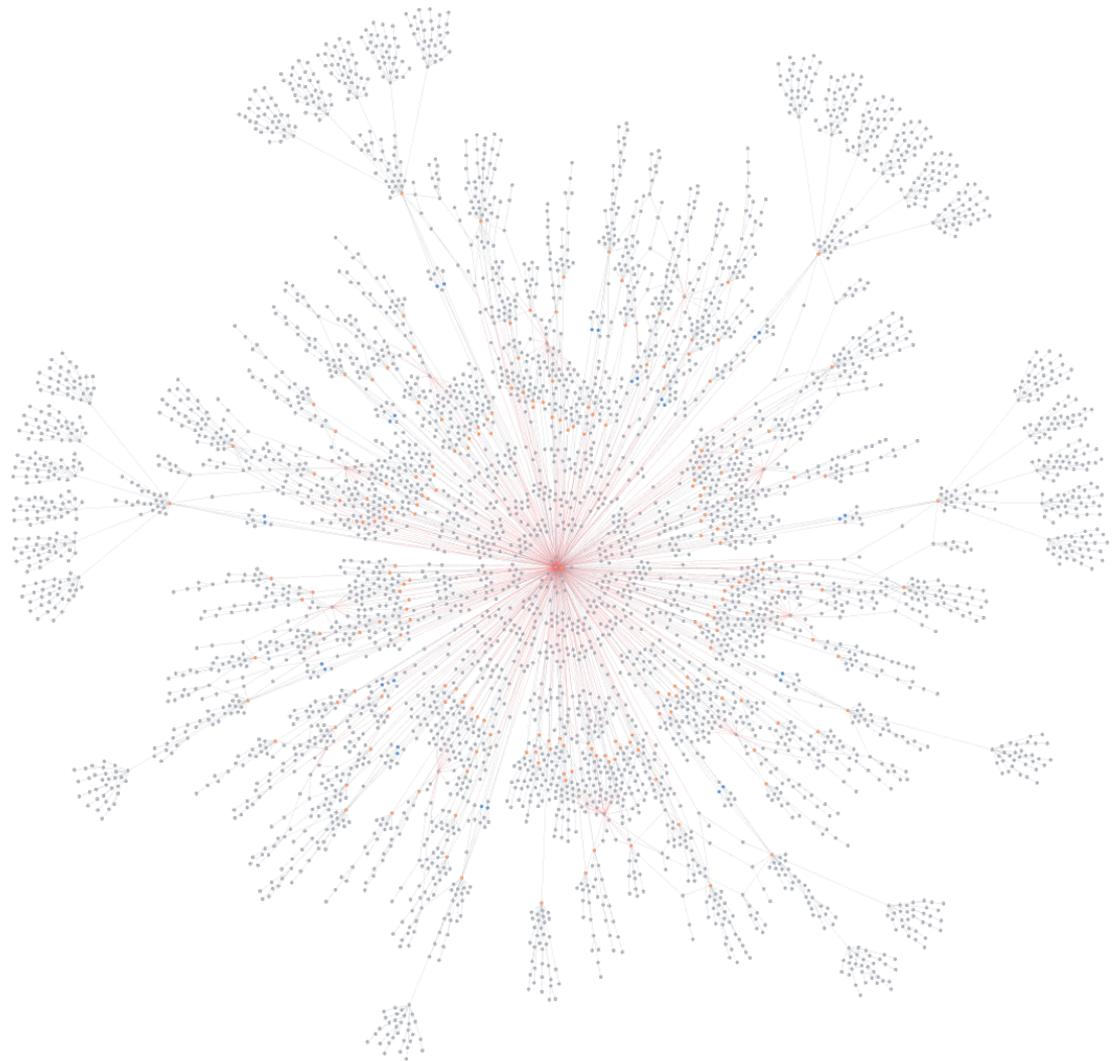
FHIR data

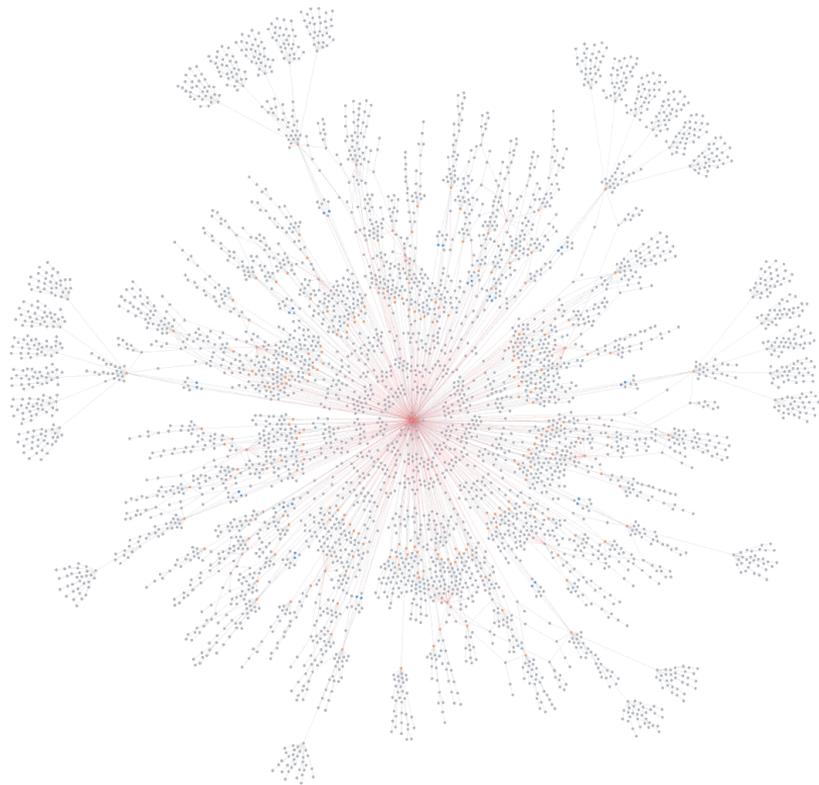


NetworkX graph



- 157 resources
- Generic conversion
- Large graphs



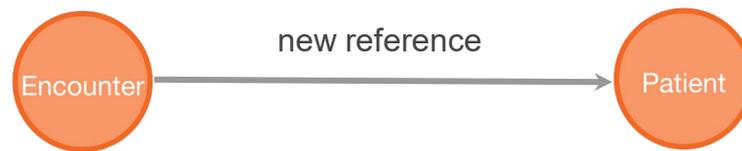
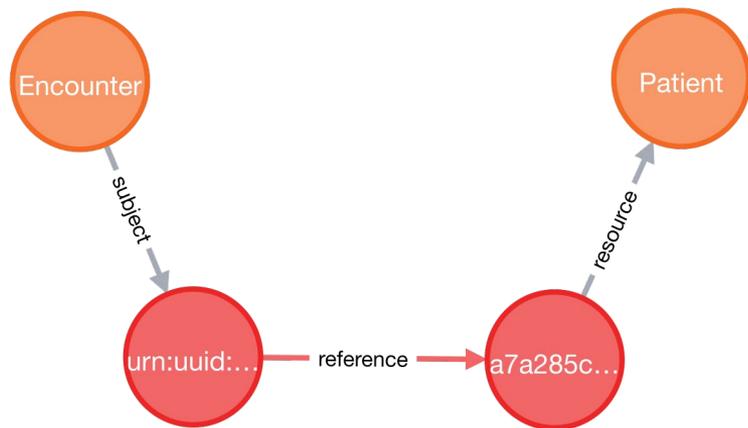


Optimisation:

- Reference path reduction
- Feature path convolution

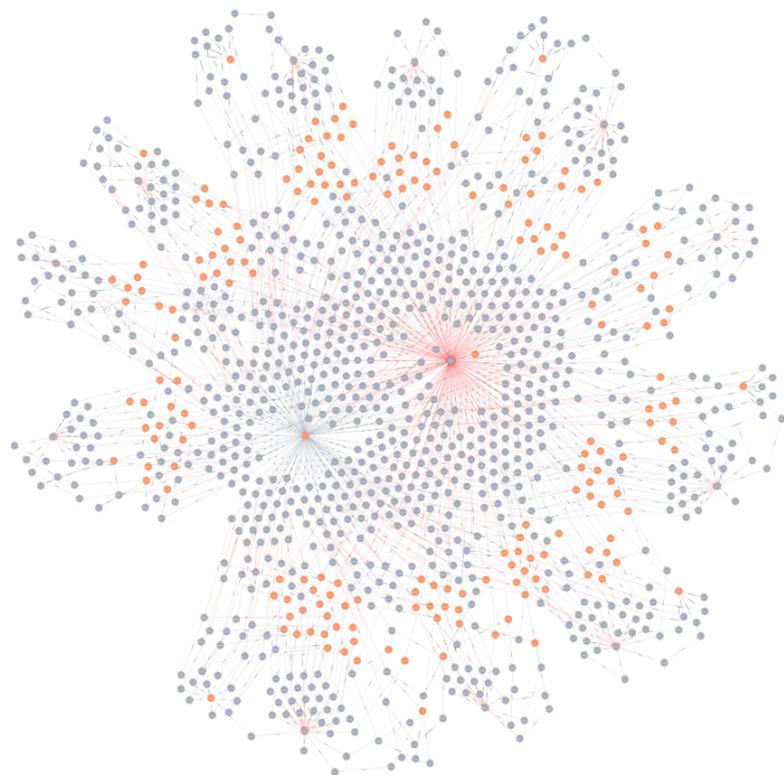
Generic bundle conversion



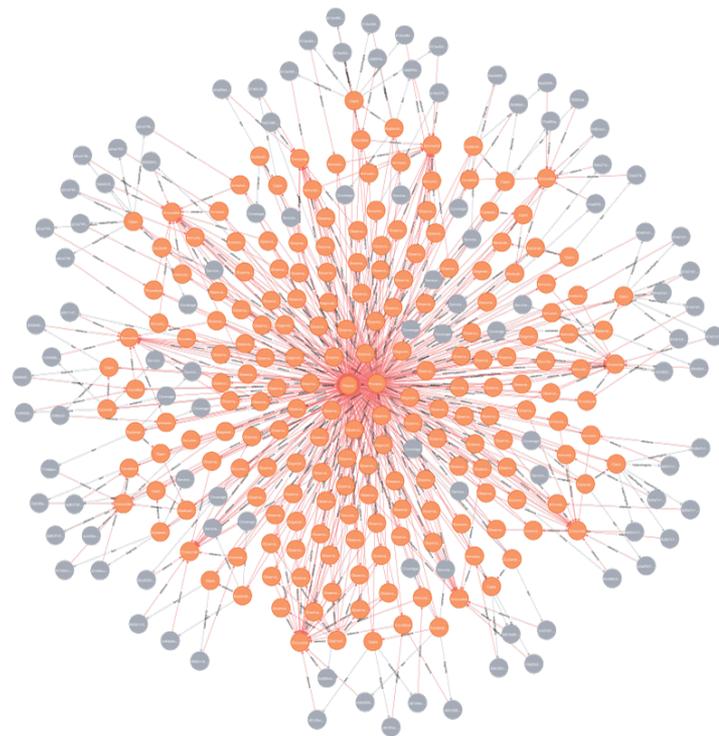


Reference path
Reduction strategy



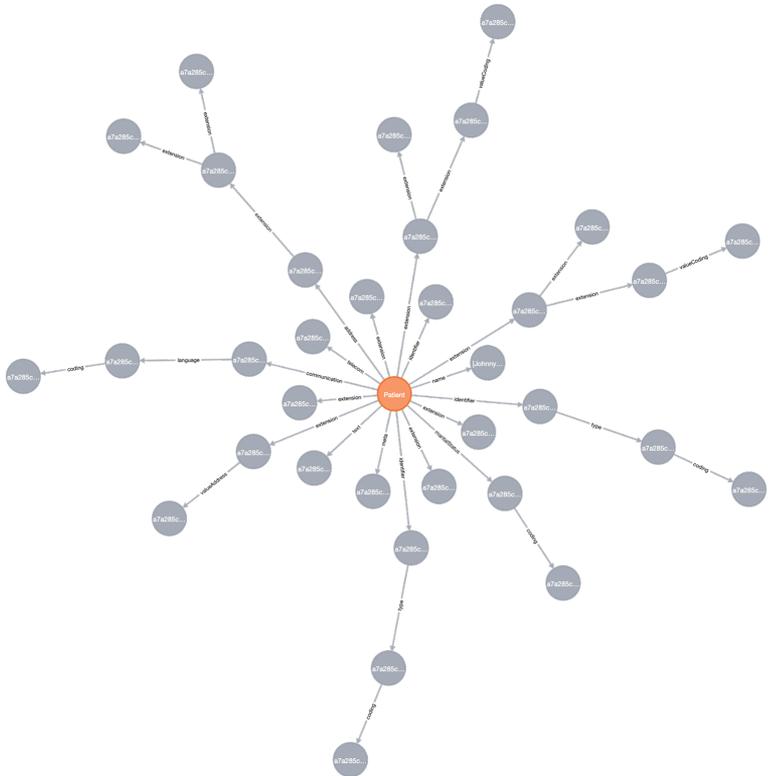


Reference paths before reduction



Reference paths after reduction



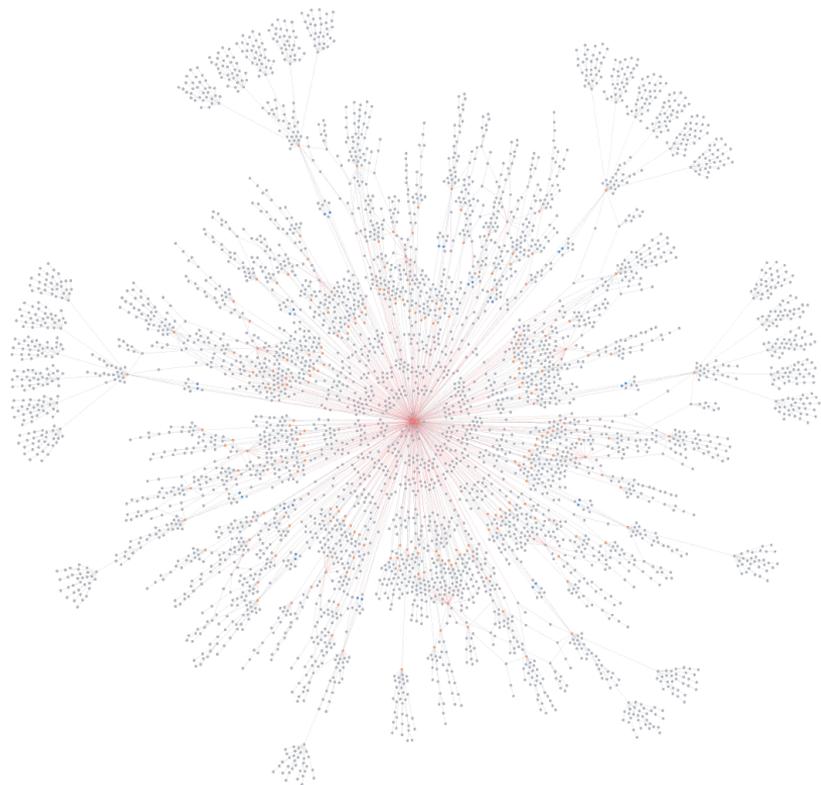


Feature paths before convolution

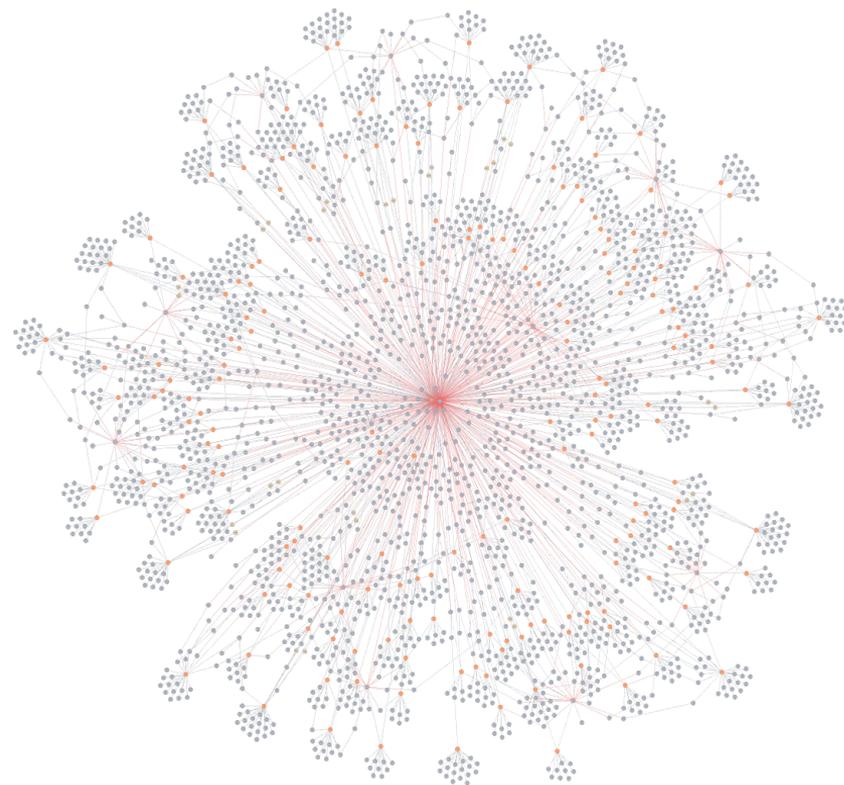


Feature paths after convolution



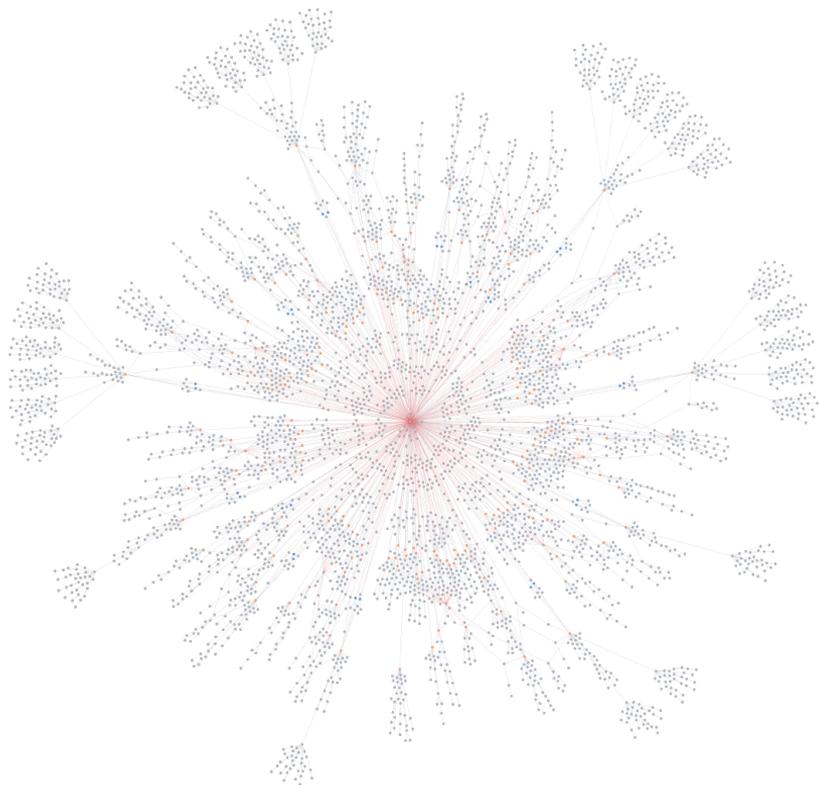


Generic bundle conversion

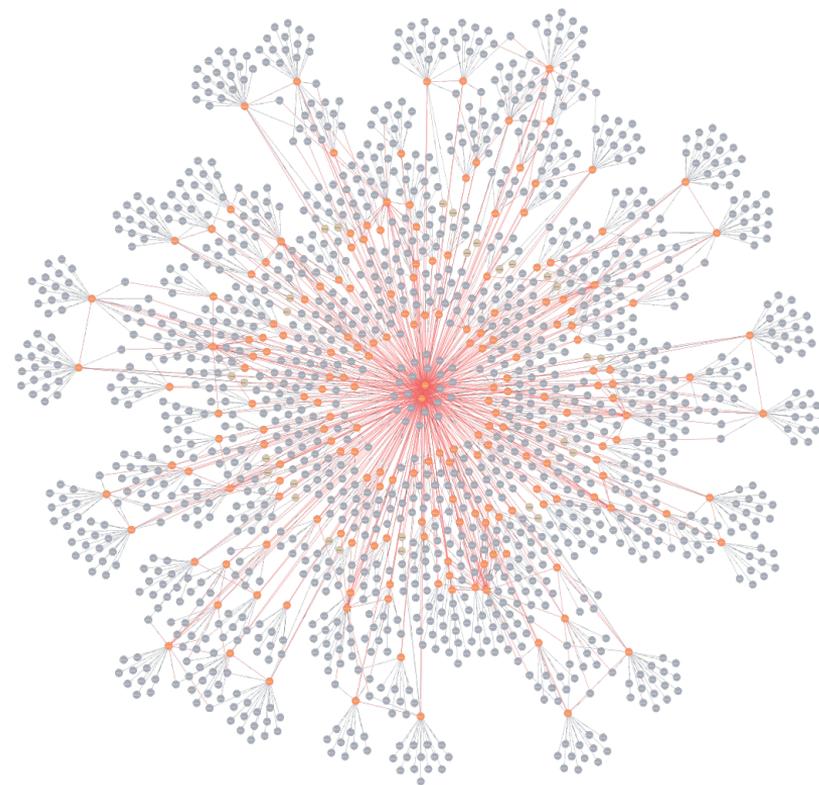


Feature convolution





Generic bundle conversion



Optimised structure

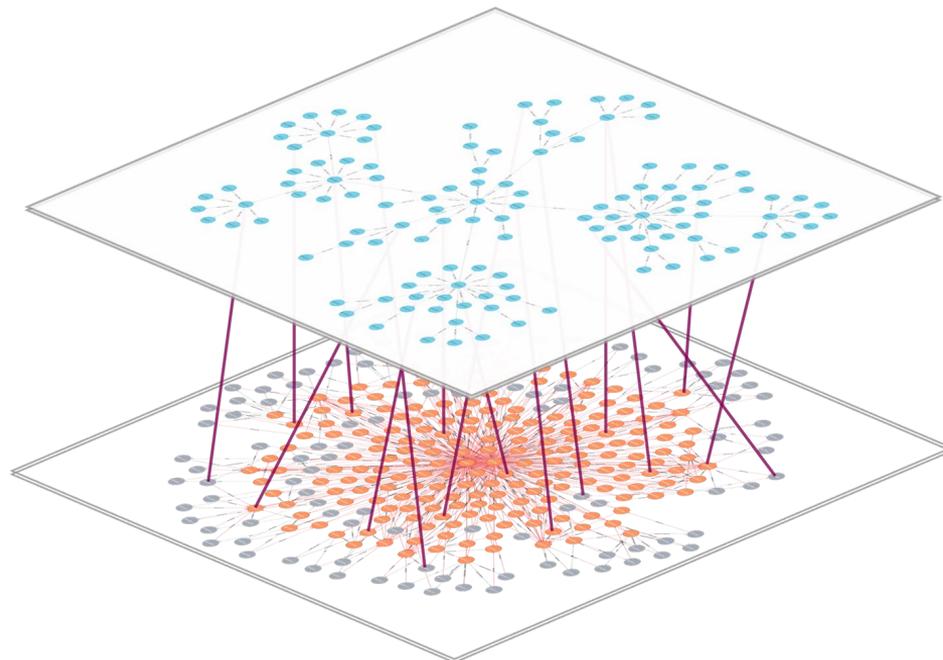




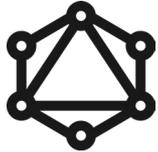
Ontology integration



BioCypher



MeDaX pipeline



Ongoing development

Prototype setup at

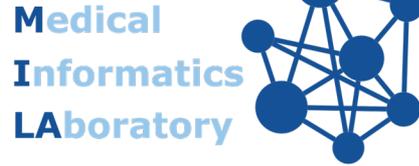


Stable release preparation:

- Testing
- Documentation
- User interface (UI)
- Dockerisation



Acknowledgements



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Julio Saez-Rodriguez

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and Research



References

BioCypher paper: Lobentanzer et al., Nat. Biotech. 41, 1056–1059 (2023),
doi: 10.1038/s41587-023-01848-y

BioCypher repository: github.com/biocypher/biocypher

BioLink paper: Unni et al., Clin Transl Sci. Wiley 2022, doi: 10.1111/cts.13302

FAIR paper: Wilkinson et al., Sci Data 2016, 3:160018,
doi: 10.1038/sdata.2016.18

MeDaX-KG paper: Mazein et al., Stud Health Technol Inform. 2024, 316:367-371, doi:10.3233/SHTI240423

MILA homepage: www.medizin.uni-greifswald.de/medizininformatik

