

Student-Led Lecture Topics

This document lists the candidate student-led lecture topics, the mandatory reading papers for each topic, instructor-owned material that should not be duplicated, and the complete reference list. For lecture expectations, submission requirements, and best practices, please refer to the '[Student-Led Lecture Guidelines](#)'.

Candidate Student-Led Lecture Topics

ID	Topic	Paradigms	Mandatory Papers	Status
1	Code Completion and Program Synthesis	AR Diffusion	P1 Codex; P2 Program Synthesis with Large Language Models.; P3 CodeGen: An Open Large Language Model for Code with Mul...; P16 CodeFusion: A Pre-trained Diffusion Model for Code Gene...; P17 Diffusion on Syntax Trees for Program Synthesis.; P18 DiffuCoder; P19 Diffusion is a Code Repair Operator and Generator.	Regular
2	Program Repair, Editing, and Test-Driven Code Generation	AR Diffusion	P2 Program Synthesis with Large Language Models.; P3 CodeGen: An Open Large Language Model for Code with Mul...; P4 Less Training, More Repairing Please: Revisiting Automa...; P16 CodeFusion: A Pre-trained Diffusion Model for Code Gene...; P17 Diffusion on Syntax Trees for Program Synthesis.; P18 DiffuCoder; P19 Diffusion is a Code Repair Operator and Generator.	Regular if enough code interest
3	Mathematical Reasoning and Proof Generation	AR Diffusion	P5 Training Verifiers to Solve Math Word Problems.; P6 Minerva; P7 AlphaGeometry; P8 Llemma: An Open Language Model for Mathematics.; P9 Generative Language Modeling for Automated Theorem Prov...; P20 Diffusion-LM Improves Controllable Text Generation.; P21 DiffuSeq: Sequence-to-Sequence Text Generation with Dif...	Regular (Weihua)
4	Text Generation Beyond Left-to-Right Decoding	AR Diffusion Flow Matching	P10 Language Models are Unsupervised Multitask Learners.; P20 Diffusion-LM Improves Controllable Text Generation.; P21 DiffuSeq: Sequence-to-Sequence Text Generation with Dif...; P22 Continuous Diffusion for Categorical Data.; P23 Large Language Diffusion Models.; P24 SEDD: Score Entropy Discrete Diffusion for Text Generat...; P46 Discrete Flow Matching.; P47 FlowSeq	Regular (Weiwei)
5	Discrete Flow Matching and Few-Step Text Generation	Diffusion Flow Matching Consistency /IMM	P23 Large Language Diffusion Models.; P24 SEDD: Score Entropy Discrete Diffusion for Text Generat...; P46 Discrete Flow Matching.; P47 FlowSeq; P48 FS-DFM: Fast and Accurate Long Text Generation with Few...; P64 Consistency Models.; P65 Improved Techniques for Training Consistency Models.	Regular or merge with Topic 4
6	Fast Generation: Distillation, Consistency, and Few-Step Sampling	Diffusion Flow Matching Consistency /IMM	P25 Denoising Diffusion Probabilistic Models.; P26 Score-Based Generative Modeling through Stochastic Diff...; P27 Progressive Distillation for Fast Sampling of Diffusion...; P49 Flow Matching for Generative Modeling.; P50 Flow Straight and Fast: Learning to Generate and Transf...; P64 Consistency Models.; P65 Improved Techniques for Training Consistency Models.; P66 Latent Consistency Models: Synthesizing High-Resolution...; P67 Simple and Fast Distillation of Diffusion Models.	Regular
7	Diffusion versus Flow Matching in Continuous Signals	Diffusion Flow Matching	P25 Denoising Diffusion Probabilistic Models.; P28 High-Resolution Image Synthesis with Latent Diffusion M...; P49 Flow Matching for Generative Modeling.; P50 Flow Straight and Fast: Learning to Generate and Transf...; P51 Building Normalizing Flows with Stochastic Interpolants.; P52 Scaling Rectified Flow Transformers for High-Resolution...; P53 Flow Matching Guide and Code.	Regular if students want theory/application bridge (Sijie)
8	Image, Video, Audio, and Speech Generation Beyond the Instructor Examples	Diffusion Flow Matching Consistency /IMM	P28 High-Resolution Image Synthesis with Latent Diffusion M...; P29 Video Diffusion Models.; P30 DiffWave: A Versatile Diffusion Model for Audio Synthesis.; P50 Flow Straight and Fast: Learning to Generate and Transf...; P52 Scaling Rectified Flow Transformers for High-Resolution...; P66 Latent Consistency Models: Synthesizing High-Resolution...; P67 Simple and Fast Distillation of Diffusion Models.	Backup / broad continuous-signal topic
9	Node-Selection in Graphs: MIS, MaxCut, MaxClique, Vertex Cover	AR / neural construction RL-Based Generation Diffusion	P68 Pointer Networks.; P69 Attention, Learn to Solve Routing Problems! (Attention...; P70 DIMES: A Differentiable Meta Solver for Combinatorial Opt...; P31 DIFUSCO: Graph-based Diffusion Solvers for Combinatoria...; P32 A Diffusion Model Framework for Unsupervised Neural Com...; P33 DISCO: Efficient Diffusion Solver for Large-Scale Combin...; P34 EDISCO: Equivariant Continuous-Time Categorical Diffusi...; P35 CAM: Combinatorial Adjoint Matching.	Regular (Shengyu)
10	Unified Neural Solvers for NP-Hard Problems	Diffusion Energy-Based / Search-Based/RL-Based Generation	P31 DIFUSCO: Graph-based Diffusion Solvers for Combinatoria...; P32 A Diffusion Model Framework for Unsupervised Neural Com...; P33 DISCO: Efficient Diffusion Solver for Large-Scale Combin...; P34 EDISCO: Equivariant Continuous-Time Categorical Diffusi...; P35 CAM: Combinatorial Adjoint Matching.; P70 DIMES: A Differentiable Meta Solver for Combinatorial Opt...; P73 Erdős Goes Neural: An Unsupervised Learning Framework f...; P74 Learning to Solve Circuit-SAT: An Unsupervised Differen...; P71 Learning Combinatorial Optimization Algorithms over Graphs.	Regular (Yixin)

ID	Topic	Paradigm s	Mandatory Papers	Status
11	Molecular Graph Generation	AR Diffusion Flow Matching	P13 GraphRNN: Generating Realistic Graphs.; P38 DiGress: Discrete Denoising Diffusion for Graph Generat...; P39 Equivariant Diffusion for Molecule Generation in 3D.; P40 GeoDiff: A Geometric Diffusion Model for Molecular Conf...; P56 CatFlow; P57 FlowMol; P58 Improving Molecular Graph Generation with Flow Matching...	Regular (Shanda)
12	3D Molecule Generation and Drug Discovery	AR Diffusion Flow Matching GFlowNet	P13 GraphRNN: Generating Realistic Graphs.; P40 GeoDiff: A Geometric Diffusion Model for Molecular Conf...; P41 Structure-Based Drug Design with Equivariant Diffusion...; P42 3D Equivariant Diffusion for Target-Aware Molecule Gene...; P57 FlowMol; P59 Equivariant Flow Matching for 3D Molecule Generation.; P60 FlowMol3: Flow Matching for 3D De Novo Small-Molecule G...; P75 Flow Network Based Generative Models for Non-Iterative...; P76 Trajectory Balance: Improved Credit Assignment in GFlow...; P77 Synthesizable Molecular Generation Using GFlowNets / Re...	Optional: if right students choose it
13	Protein Sequence and Structure Generation	AR Diffusion Flow Matching	P14 Biological Structure and Function Emerge from Scaling U...; P15 Simulating 500 Million Years of Evolution with a Langua...; P43 De Novo Design of Protein Structure and Function with R...; P44 SE(3) Diffusion Model with Application to Protein Backb...; P45 Diffusion Probabilistic Modeling of Protein Backbones i...; P61 FoldFlow; P62 Proteina: Scaling Flow-based Protein Structure Generative Models.; P63 Generalized Protein Pocket Generation with Prior-Inform...; P79 Flow Matching Meets Biology and Life Science: A Survey.; P80 Generative Modeling in Protein Design: Neural Representations, Conditional Generation, and Evaluation Standards.	Optional: if right students choose it
14	Generative Models for Scientific Discovery	AR Diffusion Flow Matching GFlowNet	P13 GraphRNN: Generating Realistic Graphs.; P14 Biological Structure and Function Emerge from Scaling U...; P40 GeoDiff: A Geometric Diffusion Model for Molecular Conf...; P43 De Novo Design of Protein Structure and Function with R...; P57 FlowMol; P61 FoldFlow; P75 Flow Network Based Generative Models for Non-Iterative...; P78 GFlowNets for AI-Driven Scientific Discovery.; P79 Flow Matching Meets Biology and Life Science: A Survey.; P80 Generative Modeling in Protein Design.	Backup synthesis topic
15	Generative Planning and Control	Diffusion Flow Matching	P81 Planning with Diffusion for Flexible Behavior Synthesis; P82 Is Conditional Generative Modeling All You Need for Decision-Making?; P83 Diffusion Policy: Visuomotor Policy Learning via Action Diffusion; P84 Motion Planning Diffusion: Learning and Adapting Robot Motion Planning with Diffusion Models; P85 DiffuserLite: Towards Real-time Diffusion Planning; P86 What Makes a Good Diffusion Planner for Decision Making?; P87 FlowMP: Learning Motion Fields for Robot Planning with Conditional Flow Matching; P88 Safe Flow Matching: Robot Motion Planning with Control Barrier Functions.	Regular
16	General Graph Generation	AR Diffusion Flow Matching	P13 GraphRNN: Generating Realistic Graphs; P38 DiGress: Discrete Denoising Diffusion for Graph Generation; P54 DeFoG: Discrete Flow Matching for Graph Generation; P56 Variational Flow Matching for Graph Generation (CatFlow); P89 Score-based Generative Modeling of Graphs via the System of Stochastic Differential Equations; P90 GraphGDP: Generative Diffusion Processes for Permutation-Invariant Graph Generation; P91 EDGE: Efficient and Degree-Guided Graph Generation via Discrete Diffusion Modeling; P92 COMETH: A Continuous-Time Discrete-State Graph Diffusion Model.	Regular

Instructor-Led Material Not to Duplicate

- Autoregressive models through language modeling.
- Energy-based models through image generation.
- Diffusion models through image generation.
- Flow matching through image generation.
- Consistency / IMM-style models through image generation.
- TSP as an instructor-led graph-structured case study.

Reference List

Paper IDs are intentionally plain integers. Paradigm labels are descriptive tags only; they are not part of the identifier.

ID	Tag	Citation
P1	AR / language-model based	Chen et al. Evaluating Large Language Models Trained on Code (Codex).
P2	AR / language-model based	Austin et al. Program Synthesis with Large Language Models.
P3	AR / language-model based	Nijkamp et al. CodeGen: An Open Large Language Model for Code with Multi-Turn Program Synthesis.
P4	AR / language-model based	Xia and Zhang. Less Training, More Repairing Please: Revisiting Automated Program Repair via Zero-shot Learning.
P5	AR / language-model based	Cobbe et al. Training Verifiers to Solve Math Word Problems.
P6	AR / language-model based	Lewkowycz et al. Solving Quantitative Reasoning Problems with Language Models (Minerva).
P7	AR / language-model based	Trinh et al. Solving Olympiad Geometry without Human Demonstrations (AlphaGeometry).
P8	AR / language-model based	Azerbayev et al. Llemma: An Open Language Model for Mathematics.

ID	Tag	Citation
P9	AR / language-model based	Polu and Sutskever. Generative Language Modeling for Automated Theorem Proving.
P10	AR / language-model based	Radford et al. Language Models are Unsupervised Multitask Learners. (Background reference.)
P11	AR / language-model based	Selsam et al. Learning a SAT Solver from Single-Bit Supervision (NeuroSAT).
P12	AR / language-model based	Yolcu and Póczos. Learning Local Search Heuristics for Boolean Satisfiability.
P13	AR / language-model based	You et al. GraphRNN: Generating Realistic Graphs.
P14	AR / language-model based	Rives et al. Biological Structure and Function Emerge from Scaling Unsupervised Learning to 250 Million Protein Sequences (ESM).
P15	AR / language-model based	Hayes et al. Simulating 500 Million Years of Evolution with a Language Model (ESM3).
P16	Diffusion	Singh et al. CodeFusion: A Pre-trained Diffusion Model for Code Generation.
P17	Diffusion	Kapur, Jenner, and Russell. Diffusion on Syntax Trees for Program Synthesis.
P18	Diffusion	Gong et al. DiffuCoder: Understanding and Improving Masked Diffusion Models for Code Generation.
P19	Diffusion	Singh et al. Diffusion is a Code Repair Operator and Generator.
P20	Diffusion	Li et al. Diffusion-LM Improves Controllable Text Generation.
P21	Diffusion	Gong et al. DiffuSeq: Sequence-to-Sequence Text Generation with Diffusion Models.
P22	Diffusion	Dieleman et al. Continuous Diffusion for Categorical Data. (Background if discrete diffusion needs a conceptual bridge.)
P23	Diffusion	Nie et al. Large Language Diffusion Models.
P24	Diffusion	Shi et al. SEDD: Score Entropy Discrete Diffusion for Text Generation.
P25	Diffusion	Ho, Jain, and Abbeel. Denoising Diffusion Probabilistic Models.
P26	Diffusion	Song et al. Score-Based Generative Modeling through Stochastic Differential Equations.
P27	Diffusion	Salimans and Ho. Progressive Distillation for Fast Sampling of Diffusion Models.
P28	Diffusion	Rombach et al. High-Resolution Image Synthesis with Latent Diffusion Models.
P29	Diffusion	Ho et al. Video Diffusion Models.
P30	Diffusion	Kong et al. DiffWave: A Versatile Diffusion Model for Audio Synthesis.
P31	Diffusion	Sun and Yang. DIFUSCO: Graph-based Diffusion Solvers for Combinatorial Optimization.
P32	Diffusion	Sanokowski et al. A Diffusion Model Framework for Unsupervised Neural Combinatorial Optimization (DiffUCO).
P33	Diffusion	Yu et al. DISCO: Efficient Diffusion Solver for Large-Scale Combinatorial Optimization Problems.
P34	Diffusion	Chen et al. EDISCO: Equivariant Continuous-Time Categorical Diffusion for Geometric Combinatorial Optimization.
P35	Diffusion	CAM: Combinatorial Adjoint Matching.
P36	Diffusion	Freivalds and Kozlovics. Denoising Diffusion for Sampling SAT Solutions.
P37	Diffusion	Chen et al. Discrete Diffusion for Complex Reasoning and Planning.
P38	Diffusion	Vignac et al. DiGress: Discrete Denoising Diffusion for Graph Generation.
P39	Diffusion	Hoogeboom et al. Equivariant Diffusion for Molecule Generation in 3D.
P40	Diffusion	Xu et al. GeoDiff: A Geometric Diffusion Model for Molecular Conformation Generation.
P41	Diffusion	Schneuing et al. Structure-Based Drug Design with Equivariant Diffusion Models (DiffSBDD).
P42	Diffusion	Guan et al. 3D Equivariant Diffusion for Target-Aware Molecule Generation and Affinity Prediction.
P43	Diffusion	Watson et al. De Novo Design of Protein Structure and Function with RFdiffusion.
P44	Diffusion	Yim et al. SE(3) Diffusion Model with Application to Protein Backbone Generation (FrameDiff).
P45	Diffusion	Trippe et al. Diffusion Probabilistic Modeling of Protein Backbones in 3D for the Motif-Scaffolding Problem.
P46	Flow Matching	Gat et al. Discrete Flow Matching.
P47	Flow Matching	Hu et al. Flow Matching for Conditional Text Generation in a Few Sampling Steps (FlowSeq).
P48	Flow Matching	Apple ML. FS-DFM: Fast and Accurate Long Text Generation with Few-Step Discrete Flow Matching.
P49	Flow Matching	Lipman et al. Flow Matching for Generative Modeling.
P50	Flow Matching	Liu, Gong, and Liu. Flow Straight and Fast: Learning to Generate and Transfer Data with Rectified Flow.
P51	Flow Matching	Albergo and Vanden-Eijnden. Building Normalizing Flows with Stochastic Interpolants.
P52	Flow Matching	Esser et al. Scaling Rectified Flow Transformers for High-Resolution Image Synthesis.
P53	Flow Matching	Meta AI. Flow Matching Guide and Code. (Background reference.)
P54	Flow Matching	Qin et al. DeFoG: Discrete Flow Matching for Graph Generation.
P55	Flow Matching	Kurtz et al. Constrained Flow Matching via Lagrangian Dual Flows.
P56	Flow Matching	Eijkelboom et al. Variational Flow Matching for Graph Generation (CatFlow).
P57	Flow Matching	Dunn and Koes. Mixed Continuous and Categorical Flow Matching for 3D De Novo Molecule Generation (FlowMol).
P58	Flow Matching	Jo et al. Improving Molecular Graph Generation with Flow Matching and Optimal Transport (GGFlow).
P59	Flow Matching	Bose et al. Equivariant Flow Matching for 3D Molecule Generation.
P60	Flow Matching	Dunn and Koes. FlowMol3: Flow Matching for 3D De Novo Small-Molecule Generation.
P61	Flow Matching	Bose et al. SE(3)-Stochastic Flow Matching for Protein Backbone Generation (FoldFlow).
P62	Flow Matching	Geffner et al. Proteina: Scaling Flow-based Protein Structure Generative Models.
P63	Flow Matching	Zhang et al. Generalized Protein Pocket Generation with Prior-Informed Flow Matching (PocketFlow).
P64	Consistency / IMM-style	Song et al. Consistency Models.
P65	Consistency / IMM-style	Song and Dhariwal. Improved Techniques for Training Consistency Models.
P66	Consistency / IMM-style	Luo et al. Latent Consistency Models: Synthesizing High-Resolution Images with Few-Step Inference.
P67	Consistency / IMM-style	Zhou et al. Simple and Fast Distillation of Diffusion Models.
P68	AR / RL / neural solver	Vinyals, Fortunato, and Jaitly. Pointer Networks. (Historical precursor; include only if useful for the lecture narrative.)
P69	AR / RL / neural solver	Kool, van Hoof, and Welling. Attention, Learn to Solve Routing Problems! (Attention Model).

ID	Tag	Citation
P70	RL-based generation	Qiu, Sun, and Yang. DIMES: A Differentiable Meta Solver for Combinatorial Optimization.
P71	RL-based generation	Khalil et al. Learning Combinatorial Optimization Algorithms over Graphs.
P72	Energy-based / search-based	Du and Mordatch. Implicit Generation and Modeling with Energy Based Models.
P73	Energy-based / search-based	Karalias and Loukas. Erdős Goes Neural: An Unsupervised Learning Framework for Combinatorial Optimization on Graphs.
P74	Energy-based / search-based	Amizadeh et al. Learning to Solve Circuit-SAT: An Unsupervised Differentiable Approach.
P75	GFlowNet	Bengio et al. Flow Network Based Generative Models for Non-Iterative Diverse Candidate Generation. (Canonical GFlowNet paper; includes molecular-graph candidate generation.)
P76	GFlowNet	Malkin et al. Trajectory Balance: Improved Credit Assignment in GFlowNets. (Core GFlowNet training objective.)
P77	GFlowNet	Koziarski et al. RGFN: Synthesizable Molecular Generation Using GFlowNets.
P78	GFlowNet	Jain et al. GFlowNets for AI-Driven Scientific Discovery. (Survey/background.)
P79	Survey / background	Li et al. Flow Matching Meets Biology and Life Science: A Survey.
P80	Survey / background	Wanasekara et al. Generative Modeling in Protein Design: Neural Representations, Conditional Generation, and Evaluation Standards.
P81	Diffusion / planning	Janner et al. Planning with Diffusion for Flexible Behavior Synthesis (Diffuser).
P82	Diffusion / planning	Ajay et al. Is Conditional Generative Modeling All You Need for Decision-Making? (Decision Diffuser).
P83	Diffusion / policy	Chi et al. Diffusion Policy: Visuomotor Policy Learning via Action Diffusion.
P84	Diffusion / planning	Carvalho et al. Motion Planning Diffusion: Learning and Adapting Robot Motion Planning with Diffusion Models.
P85	Diffusion / planning	Dong et al. DiffuserLite: Towards Real-time Diffusion Planning.
P86	Diffusion / planning	Lu et al. What Makes a Good Diffusion Planner for Decision Making?
P87	Flow Matching / planning	Nguyen et al. FlowMP: Learning Motion Fields for Robot Planning with Conditional Flow Matching.
P88	Flow Matching / planning	Dai et al. Safe Flow Matching: Robot Motion Planning with Control Barrier Functions.
P89	Diffusion	Jo et al. Score-based Generative Modeling of Graphs via the System of Stochastic Differential Equations.
P90	Diffusion	Chen et al. GraphGDP: Generative Diffusion Processes for Permutation-Invariant Graph Generation.
P91	Diffusion	Chen et al. EDGE: Efficient and Degree-Guided Graph Generation via Discrete Diffusion Modeling.
P92	Diffusion	Siraudin et al. COMETH: A Continuous-Time Discrete-State Graph Diffusion Model.

Instructor lectures establish canonical paradigms and foundational papers. Student lectures explore the research space beyond those canonical anchors. Any paper discussed in an instructor lecture may be cited for context but cannot count toward the required paper set for a student lecture.

- **Category A: Instructor-owned canonical papers**

- These are fair games for you but prohibited as mandatory student papers.

- Examples:

- **AR**

- RNN LM

- Seq2Seq

- Attention

- Transformer

- BERT

- **Diffusion**

- DDPM

- DDIM

- Score-based diffusion

- **FM**

- Flow Matching

- Rectified Flow

- **EBM**

- One or two canonical EBMs

- **CO**
- PointerNet
- AM
- DIFUSCO
- DIMES