AI/ML Career Roles - Skills & Topics Mapping Guide

Practical Career Path Mapping for AI/ML Professionals
Published: November 16, 2025

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Role Overview Matrix

🎯 Primary Career Paths

Role Category	Entry Level	Mid Level	Senior Level
Technical	Data Analyst, Junior DS	Data Scientist, ML Engineer	Principal ML Engineer, Research Scientist
Specialized	CV/NLP Engineer	Senior CV/NLP Engineer	Distinguished Engineer, Technical Fellow
Business	Product Manager	Senior PM	Director, VP Product
Leadership	Team Lead	Engineering Manager	Director, CTO, Head of AI

📊 Skills Importance Scale

- 🟢 **Essential**: Must know for role success
- 🟡 **Important**: Highly beneficial, role-specific value

- 🔵 **Useful**: Nice to have, adds value
- ⚪ **Optional**: Nice to have, not required

Core Technical Roles

1. Data Scientist

Primary Focus: Extract insights from data, build predictive models, drive business decisions

🟢 Essential Skills & Topics:

- **Programming**: Python (Pandas, NumPy, Scikit-learn), SQL
- **Statistics**: Descriptive statistics, hypothesis testing, Bayesian inference
- **ML Algorithms**: Regression, classification, clustering, tree-based models
- **Data Processing**: Data cleaning, feature engineering, pipeline creation
- **Visualization**: Matplotlib, Seaborn, Tableau, storytelling
- **Mathematics**: Linear algebra, calculus, probability theory

🟡 Important Skills:

- **Advanced ML**: Ensemble methods, hyperparameter tuning, cross-validation
- **Big Data**: Spark, distributed computing, cloud platforms
- **Experiment Design**: A/B testing, causal inference, statistical significance
- **Business Intelligence**: Dashboard creation, KPI design, business metrics

🔵 Useful Skills:

- **Deep Learning**: Neural networks, basic CNN/RNN knowledge
- **MLOps**: Model deployment basics, monitoring
- **Specialized Domains**: Domain expertise (finance, healthcare, etc.)
- **Programming**: R, Scala, Java for specific environments

📚 Learning Path:

```
Foundation (3-6 months):
Python + Statistics + Basic ML

Core Skills (6-12 months):
Advanced ML + Feature Engineering + Visualization

Specialization (12-18 months):
Domain expertise + Big Data + MLOps
```

💼 Daily Responsibilities:

- Analyze business data to identify trends and opportunities
- Build and evaluate machine learning models
- Create data visualizations and reports
- Collaborate with business stakeholders
- Design and analyze experiments
- Present findings to technical and non-technical audiences

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2. Machine Learning Engineer

Primary Focus: Production ML systems, model deployment, scalable infrastructure

🟢 Essential Skills & Topics:

- **Programming**: Python, software engineering best practices
- **ML Frameworks**: Scikit-learn, TensorFlow, PyTorch
- **Deployment**: FastAPI, Docker, Kubernetes, cloud platforms (AWS/GCP/Azure)
- **Data Engineering**: ETL pipelines, data validation, feature stores
- **MLOps**: CI/CD for ML, model versioning, experiment tracking
- **System Design**: Scalability, performance optimization, monitoring

🟡 Important Skills:

- **Distributed Computing**: Apache Spark, Dask, multiprocessing
- **Database Systems**: SQL, NoSQL, vector databases
- **DevOps**: Git, CI/CD pipelines, infrastructure as code
- **Model Optimization**: Quantization, pruning, model compression

🔵 Useful Skills:

- **Advanced Algorithms**: Recommendation systems, search ranking
- **Edge Deployment**: Mobile optimization, edge computing
- **Security**: Model security, adversarial attacks, privacy
- **Programming**: Java/Scala for large-scale systems

📚 Learning Path:

```
Foundation (6-9 months):
Python + Software Engineering + Basic ML

Core Skills (9-15 months):
Deep Frameworks + Deployment + System Design

Specialization (15-24 months):
MLOps + Cloud + Large-scale Systems
```

💼 Daily Responsibilities:

- Build and maintain ML production systems
- Optimize model performance and scalability
- Create robust data pipelines
- Monitor model performance and drift
- Collaborate with data scientists and DevOps teams
- Implement security and privacy measures

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3. Research Scientist

Primary Focus: Algorithm development, novel research, academic/industry research

🟢 Essential Skills & Topics:

- **Mathematics**: Advanced linear algebra, calculus, probability, optimization
- **Deep Learning**: Neural networks, advanced architectures, backpropagation
- **Research Methods**: Experimental design, statistical analysis, paper writing
- **Programming**: Python, PyTorch/TensorFlow, numerical computing
- **Literature Review**: Stay current with latest research, identify research gaps
- **Academic Skills**: Paper writing, peer review, conference presentations

🟡 Important Skills:

- **Specialized Areas**: Computer Vision, NLP, Reinforcement Learning
- **Advanced Topics**: Attention mechanisms, transformer architectures
- **Collaboration**: Multi-disciplinary research, team collaboration
- **Industry Applications**: Understanding practical impact and constraints

🔵 Useful Skills:

- **Emerging Technologies**: Quantum computing, neuromorphic computing
- **Programming**: C++ for performance, CUDA for GPU programming
- **Academic**: PhD-level coursework, research methodology
- **Communication**: Technical writing, conference presentations

📚 Learning Path:

```
Foundation (12-18 months):
Advanced Math + Deep Learning Theory + Research Methods

Core Skills (18-24 months):
Specialized Domain + Advanced Algorithms + Literature Review

Expertise (24+ months):
Cutting-edge Research + Novel Contributions + Leadership
```

💼 Daily Responsibilities:

- Design and conduct research experiments
- Develop novel algorithms and architectures
- Write and submit research papers
- Collaborate with academic and industry partners
- Present research at conferences and workshops
- Mentor junior researchers

Specialized AI Roles

4. Computer Vision Engineer

Primary Focus: Image processing, visual recognition, CV applications

🟢 Essential Skills & Topics:

- **Image Processing**: OpenCV, PIL, image augmentation
- **Computer Vision**: Feature detection, image segmentation, object detection
- **Deep Learning**: CNNs, vision transformers, transfer learning
- **Libraries**: OpenCV, PIL, Albumentations, MMDetection
- **Domain Knowledge**: Camera systems, image formats, color spaces
- **Evaluation Metrics**: IoU, mAP, precision-recall curves

🟡 Important Skills:

- **Advanced CV**: Semantic segmentation, instance segmentation, pose estimation
- **Real-time Processing**: Video processing, streaming optimization
- **Deployment**: Edge deployment, mobile optimization, model compression
- **Specialized Applications**: Medical imaging, autonomous vehicles, AR/VR

🔵 Useful Skills:

- **Graphics**: 3D vision, stereo vision, structure from motion
- **Hardware**: GPU programming, embedded systems
- **Programming**: C++ for performance, CUDA for GPU acceleration
- **Related Fields**: Robotics, graphics, human-computer interaction

📚 Learning Path:

```
Foundation (3-6 months):
Image Processing + OpenCV + Basic Computer Vision

Core Skills (6-12 months):
Deep Learning for CV + CNNs + Object Detection

Specialization (12-18 months):
Advanced CV + Real-time Processing + Domain Applications
```

💼 Daily Responsibilities:

- Develop computer vision algorithms and models
- Process and analyze image/video data
- Optimize models for performance and accuracy
- Collaborate with product teams on CV applications
- Stay current with latest CV research and techniques

- Test and validate CV solutions in real-world scenarios

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5. NLP Engineer

Primary Focus: Language understanding, text processing, conversational AI

🟢 Essential Skills & Topics:

- **Text Processing**: Tokenization, stemming, lemmatization, text cleaning
- **NLP Fundamentals**: POS tagging, named entity recognition, parsing
- **Language Models**: Word embeddings (Word2Vec, GloVe), BERT, GPT
- **Libraries**: NLTK, spaCy, Hugging Face Transformers
- **Evaluation**: BLEU, ROUGE, perplexity, human evaluation
- **Applications**: Sentiment analysis, text classification, summarization

🟡 Important Skills:

- **Advanced NLP**: Machine translation, question answering, dialogue systems
- **Transformer Architecture**: Attention mechanisms, positional encoding
- **LLM Fine-tuning**: Parameter-efficient methods, instruction tuning
- **Multilingual NLP**: Cross-lingual models, language detection

🔵 Useful Skills:

- **Speech Processing**: ASR, TTS, speech recognition
- **Knowledge Graphs**: Entity linking, relation extraction
- **Programming**: Java for enterprise NLP, R for linguistics research
- **Linguistics**: Morphology, syntax, semantics, pragmatics

📚 Learning Path:

```
Foundation (3-6 months):
Text Processing + Basic NLP + NLTK/spaCy

Core Skills (6-12 months):
Deep Learning for NLP + Transformers + Language Models

Specialization (12-18 months):
LLM Applications + Advanced NLP + Domain Expertise
```

💼 Daily Responsibilities:

- Build NLP models for various applications
- Process and analyze text data at scale
- Develop conversational AI and chatbot systems
- Fine-tune language models for specific tasks
- Evaluate and improve NLP system performance
- Collaborate with product teams on language-related features

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6. Reinforcement Learning Engineer

Primary Focus: Decision-making systems, game AI, autonomous agents

🟢 Essential Skills & Topics:

- **RL Fundamentals**: MDPs, value functions, policy gradients
- **Algorithms**: Q-learning, policy gradient, actor-critic methods
- **Deep RL**: DQN, PPO, A3C, implementation frameworks
- **Mathematics**: Dynamic programming, optimization, probability
- **Programming**: Python, PyTorch/TensorFlow, gym environments
- **Simulation**: Environment design, reward engineering

🟡 Important Skills:

- **Advanced RL**: Multi-agent RL, hierarchical RL, meta-learning
- **Applications**: Game playing, robotics, resource allocation
- **Optimization**: Gradient-based optimization, evolutionary algorithms
- **Tools**: OpenAI Gym, Stable Baselines, Ray RLlib

🔵 Useful Skills:

- **Game Theory**: Nash equilibrium, mechanism design
- **Robotics**: Robot learning, control theory
- **Programming**: C++ for real-time systems, MATLAB for control
- **Related Fields**: Cognitive science, behavioral economics

📚 Learning Path:

```
Foundation (6-9 months):
Mathematics + Basic RL + MDPs

Core Skills (9-15 months):
Deep RL + Algorithms + Implementation

Specialization (15-24 months):
Advanced RL + Applications + Research
```

💼 Daily Responsibilities:

- Design and implement RL algorithms
- Create simulation environments for training
- Optimize agent performance and learning efficiency
- Apply RL to real-world problems and domains
- Research and develop novel RL techniques
- Collaborate with domain experts for application design

Business & Strategy Roles

7. AI Product Manager

Primary Focus: AI product strategy, user experience, business integration

🟢 Essential Skills & Topics:

- **AI Fundamentals**: Understanding of ML/AI capabilities and limitations
- **Product Management**: Roadmap planning, user research, feature definition
- **Business Strategy**: Market analysis, competitive intelligence, business models
- **Data Literacy**: Understanding of data requirements, quality, and governance
- **Communication**: Technical translation, stakeholder management, presentations
- **User Experience**: User journey mapping, interface design principles

🟡 Important Skills:

- **Technical Understanding**: High-level architecture, model evaluation, deployment
- **Analytics**: Metrics design, A/B testing, data analysis
- **Project Management**: Agile methodologies, sprint planning, resource allocation

- **Industry Knowledge**: Domain expertise, regulatory considerations

🔵 Useful Skills:

- **Programming**: Basic Python for data exploration
- **Design**: UI/UX principles, prototyping tools
- **Statistics**: Experimental design, statistical significance
- **Advanced AI**: Deep understanding of specific AI technologies

📚 Learning Path:

```
Foundation (3-6 months):
AI Fundamentals + Product Management + Business Strategy

Core Skills (6-12 months):
Data Literacy + User Experience + Communication

Specialization (12-18 months):
Industry Knowledge + Advanced Analytics + Leadership
```

💼 Daily Responsibilities:

- Define AI product vision and strategy
- Work with engineering teams to build AI features
- Conduct user research and market analysis
- Manage product roadmap and feature prioritization
- Communicate with stakeholders and executive leadership
- Measure and optimize product performance

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8. AI Business Analyst

Primary Focus: Business intelligence, process optimization, strategic planning

🟢 Essential Skills & Topics:

- **Business Analysis**: Process mapping, requirements gathering, stakeholder management
- **Data Analysis**: SQL, Excel, data visualization, statistical analysis
- **AI Understanding**: ML/AI concepts, capabilities assessment, use case identification
- **Communication**: Report writing, presentation skills, technical translation
- **Project Management**: Planning, scheduling, risk management

- **Industry Knowledge**: Domain expertise, competitive landscape

🟡 Important Skills:

- **Advanced Analytics**: Predictive modeling, forecasting, optimization
- **AI Implementation**: Model selection, performance evaluation, ROI analysis
- **Change Management**: Organizational change, training, adoption strategies
- **Tools**: BI tools (Tableau, Power BI), programming basics

🔵 Useful Skills:

- **Programming**: Python, R for advanced analytics
- **AI/ML**: Basic understanding of algorithms and model evaluation
- **Process Improvement**: Lean, Six Sigma, continuous improvement
- **Consulting**: Framework thinking, client management

📚 Learning Path:

```
Foundation (3-6 months):
Business Analysis + Data Analysis + AI Fundamentals

Core Skills (6-12 months):
Advanced Analytics + AI Implementation + Communication

Specialization (12-18 months):
Industry Expertise + Process Optimization + Strategic Planning
```

💼 Daily Responsibilities:

- Analyze business processes and identify AI opportunities
- Gather and document business requirements for AI projects
- Create business cases and ROI analysis for AI initiatives
- Collaborate with technical teams on AI solution design
- Present findings and recommendations to leadership
- Monitor and evaluate AI project outcomes

Management & Leadership

9. AI Engineering Manager

Primary Focus: Team leadership, technical strategy, resource management

🟢 Essential Skills & Topics:

- **Technical Leadership**: Code review, architecture design, technical decisions
- **People Management**: Team building, performance management, career development
- **Strategic Planning**: Technology roadmap, resource allocation, budget management
- **Communication**: Technical communication, presentation, stakeholder management
- **ML/AI Knowledge**: Deep understanding of AI/ML technical landscape
- **Project Management**: Planning, execution, risk management

🟡 Important Skills:

- **Business Acuity**: Understanding of business impact and value creation
- **Vendor Management**: Technology partnerships, tool selection, licensing
- **Organizational Design**: Team structure, hiring, scaling
- **Industry Trends**: Staying current with AI/ML developments

🔵 Useful Skills:

- **Advanced Programming**: Deep technical expertise in multiple areas
- **Research Management**: Academic partnerships, research strategy
- **Public Speaking**: Conference presentations, thought leadership
- **Entrepreneurship**: Startup experience, business development

📚 Learning Path:

```
Foundation (6-12 months):
Technical Expertise + Leadership Training + People Management

Core Skills (12-24 months):
Strategic Planning + Business Acuity + Communication

Expertise (24+ months):
Organizational Leadership + Industry Influence + Vision
```

💼 Daily Responsibilities:

- Lead and manage AI engineering teams
- Make technical architecture and design decisions
- Plan and execute technology strategies
- Hire, mentor, and develop team members

- Communicate technical vision to leadership
- Balance technical excellence with business objectives

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10. Chief Technology Officer (CTO) - AI Focus

Primary Focus: Technology vision, company-wide AI strategy, technical leadership

🟢 Essential Skills & Topics:

- **Strategic Vision**: Long-term technology planning, AI transformation strategy
- **Technical Expertise**: Deep knowledge across AI/ML technical domains
- **Leadership**: Executive presence, board presentations, investor relations
- **Business Strategy**: Technology ROI, competitive positioning, innovation
- **Organizational Design**: Company-wide technical architecture, team scaling
- **Industry Influence**: Thought leadership, conference speaking, publications

🟡 Important Skills:

- **Financial Management**: Budget planning, investment decisions, cost optimization
- **Regulatory Knowledge**: AI governance, compliance, ethical considerations
- **Global Perspective**: International markets, global technology trends
- **Innovation Management**: R&D strategy, innovation culture, patent strategy

🔵 Useful Skills:

- **Academic Background**: PhD, research experience, academic publications
- **Startup Experience**: Entrepreneurship, fundraising, scaling
- **Industry Network**: Relationships with other CTOs, researchers, investors
- **Public Speaking**: Major conference keynotes, media appearances

📚 Learning Path:

```
Foundation (5+ years):
Deep Technical Expertise + Leadership Experience + Business Acuity

Core Skills (5-10 years):
Strategic Vision + Organizational Leadership + Industry Influence

Expertise (10+ years):
Executive Presence + Thought Leadership + Innovation Strategy
```

💼 Daily Responsibilities:

- Set company-wide technology and AI strategy
- Lead technical vision and architecture decisions
- Manage and scale technical teams organization
- Represent technology perspective to board and investors
- Drive innovation and technology adoption
- Build and maintain technology partnerships

Industry-Specific Applications

Healthcare AI

Key Skills: Medical imaging, clinical NLP, regulatory knowledge, privacy
Primary Roles: Healthcare Data Scientist, Medical AI Engineer, Clinical Research Scientist
Specialized Topics: DICOM processing, EHR analysis, drug discovery, diagnostic AI

Financial Services

Key Skills: Risk modeling, fraud detection, algorithmic trading, regulatory compliance
Primary Roles: Quantitative Analyst, Risk Modeler, Trading Algorithm Developer
Specialized Topics: Time series analysis, portfolio optimization, credit scoring

Autonomous Vehicles

Key Skills: Computer vision, sensor fusion, control systems, safety engineering
Primary Roles: Autonomous Vehicle Engineer, Perception Engineer, Planning Engineer
Specialized Topics: LiDAR processing, sensor calibration, path planning, safety validation

E-commerce & Retail

Key Skills: Recommendation systems, personalization, demand forecasting, pricing optimization
Primary Roles: Recommender Systems Engineer, Personalization Scientist, Pricing Analyst
Specialized Topics: Collaborative filtering, market basket analysis, dynamic pricing

Manufacturing & Industry 4.0

Key Skills: Predictive maintenance, quality control, supply chain optimization, IoT
Primary Roles: Industrial Data Scientist, Manufacturing AI Engineer, Supply Chain Analyst
Specialized Topics: Anomaly detection, computer vision QC, process optimization

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Skills Priority by Career Stage

Junior Level (0-2 years)

Priority Focus:
- 🟢 **Essential**: Programming fundamentals, basic ML concepts, data manipulation
- 🟡 **Important**: Statistics, visualization, basic deployment
- 🔵 **Useful**: Cloud platforms, version control, basic deep learning

Learning Approach: Hands-on projects, mentorship, foundational knowledge

Mid-Level (2-7 years)

Priority Focus:
- 🟢 **Essential**: Advanced ML algorithms, production deployment, domain expertise
- 🟡 **Important**: MLOps, system design, business understanding
- 🔵 **Useful**: Research skills, leadership opportunities, specialization

Learning Approach: Specialization depth, cross-functional collaboration, project leadership

Senior Level (7+ years)

Priority Focus:
- 🟢 **Essential**: Strategic thinking, technical leadership, business acumen
- 🟡 **Important**: Innovation, thought leadership, organizational impact
- 🔵 **Useful**: Industry influence, academic contributions, entrepreneurial activities

Learning Approach: Strategic development, mentoring others, industry leadership

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Learning Roadmaps by Role

🚀 Data Scientist → ML Engineer → AI Architect

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Year 1-2: Data Scientist
├── Python + Statistics + ML Basics
├── Business Analysis + Visualization
└── Domain Expertise Development

Year 3-5: ML Engineer
├── Production Systems + Deployment
├── MLOps + System Design
└── Cloud Platforms + Scalability

Year 6+: AI Architect
├── Strategic Planning + Leadership
├── Advanced AI Technologies
└── Organizational Impact
```

🎓 Research Track: MS/PhD → Research Scientist → Principal Researcher

```
Foundation: Advanced Degree (MS/PhD)
├── Advanced Mathematics + Research Methods
├── Deep Technical Specialization
└── Academic Collaboration

Early Career: Research Scientist
├── Algorithm Development + Publication
├── Experimental Design + Analysis
└── Technical Leadership

Senior: Principal Researcher
├── Research Strategy + Vision
├── Team Leadership + Mentorship
└── Industry Impact + Innovation
```

💼 Business Track: Analyst → PM → Director → VP

```
Year 1-3: Data/Business Analyst
├── Data Analysis + Business Intelligence
├── Communication + Stakeholder Management
└── Domain Knowledge + Process Understanding

Year 4-7: Product Manager
├── Product Strategy + User Experience
├── Technical Translation + Team Leadership
└── Market Analysis + Competitive Intelligence

Year 8+: Director/VP
├── Strategic Planning + Organizational Leadership
├── Business Development + Partnership
└── Executive Communication + Board Presentations
```

Salary & Career Progression

💰 US Market Salary Ranges (2025)

Role Level	Data Science	ML Engineering	Research	Product Management
Entry	85K– 120K	100K– 140K	110K– 150K	90K– 130K
Mid	120K– 170K	140K– 190K	150K– 210K	130K– 180K
Senior	170K– 240K	190K– 280K	210K– 350K	180K– 260K
Principal	240K– 350K	280K– 400K	350K– 500K+	260K– 400K
Director/VP	350K– 500K+	400K– 600K+	500K– 800K+	400K– 600K+

📈 Career Progression Factors

Technical Excellence:
- Deep domain expertise
- Innovation and research contributions
- System design and architecture skills
- Technical leadership and mentoring

Business Impact:
- Measurable business value creation

- Revenue and cost impact
- Strategic thinking and planning
- Cross-functional collaboration

Leadership & Communication:
- Team building and management
- Stakeholder communication
- Thought leadership and influence
- Public speaking and writing

Market Factors:
- Industry demand and competition
- Geographic location
- Company size and stage
- Specialized skills and niche expertise

Action Items by Career Stage

🎯 For Students/New Graduates

1. **Build Strong Foundation**: Master programming and statistics
2. **Create Portfolio**: 3-5 substantial projects demonstrating skills
3. **Gain Experience**: Internships, hackathons, open source contributions
4. **Network**: Join AI/ML communities, attend conferences
5. **Specialize**: Choose a domain area to focus expertise

💼 For Early Career Professionals (1-5 years)

1. **Deepen Technical Skills**: Advanced algorithms and production systems
2. **Develop Domain Expertise**: Industry knowledge and business acumen
3. **Take on Leadership**: Lead projects, mentor junior team members
4. **Build Network**: Professional relationships and industry connections
5. **Consider Specialization**: Advanced degree or certification if needed

🚀 For Senior Professionals (5+ years)

1. **Strategic Thinking**: Business impact and long-term planning
2. **Thought Leadership**: Speaking, writing, and industry influence
3. **Organizational Impact**: Team building and culture development
4. **Innovation**: Research contributions and novel solutions
5. **Mentorship**: Developing next generation of AI/ML professionals

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Conclusion

The AI/ML field offers diverse and rewarding career paths across technical, business, and leadership tracks. Success requires a combination of technical excellence, business acumen, and continuous learning.

Key Success Factors:
- **Continuous Learning**: Stay current with rapidly evolving technology
- **Practical Experience**: Build real projects and demonstrate impact
- **Communication Skills**: Translate technical concepts for business audiences
- **Business Understanding**: Connect AI capabilities to business value
- **Network Building**: Professional relationships and industry connections

Timeline Expectations:
- **Entry Level**: 0-2 years (focus on fundamentals)
- **Mid Level**: 2-7 years (develop specialization and leadership)
- **Senior Level**: 7+ years (strategic impact and thought leadership)

Choose your path based on interests, strengths, and market opportunities. The field rewards both deep technical expertise and strong business impact.

This guide provides a comprehensive roadmap for AI/ML career development. Adapt recommendations based on your specific situation, interests, and market opportunities.
Last Updated: November 16, 2025
Roles Covered: 10+ career paths with detailed skill mappings