

SUBDOMAINS	FOCUS	KEY TECHNOLOGIES	SKILLS	APPLICATIONS	EXAMPLE COMPANIES
INDUSTRIAL ROBOTICS	Automation of manufacturing processes	<ul style="list-style-type: none"> • Robotic Arms • CNC Machines, PLCs (Programmable Logic Controllers) 	<ul style="list-style-type: none"> • Programming: Proficiency in languages like C/C++, Python, and PLC programming. • Mechanical Engineering: Knowledge of CAD software (e.g., SolidWorks, AutoCAD) for designing robotic components. • Control Systems: Understanding of control theory and industrial automation systems. • Sensors and Actuators: Experience with various sensors (proximity, vision) and actuators (motors, pneumatics). • Manufacturing Processes: Familiarity with processes like welding, assembly, and packaging. 	<ul style="list-style-type: none"> • Assembly Lines • Welding • Painting • Packaging • Material Handling 	<ul style="list-style-type: none"> • ABB: Develop industrial robotic arms • Fanuc: Specializes in robotic automation for manufacturing • KUKA
SERVICE ROBOTICS	Robots designed to assist humans in various tasks	<ul style="list-style-type: none"> • Mobile Robots • Humanoid Robots, • Robotic Process Automation (RPA) 	<ul style="list-style-type: none"> • Artificial Intelligence: Knowledge of AI and machine learning algorithms. • Human-Robot Interaction: Understanding of user interface design and human-robot interaction principles. • Programming: Skills in high-level programming languages like Python and C++. • Mobile Robotics: Experience with navigation algorithms and localization. • Customer Service: Ability to design robots that can perform customer service roles. 	<ul style="list-style-type: none"> • Domestic tasks (cleaning, mowing) • Healthcare (surgery, rehabilitation) • Customer Service 	<ul style="list-style-type: none"> • iRobot (Roomba) • SoftBank Robotics (Pepper)
MEDICAL ROBOTICS	Robotics applications in the healthcare sector	<ul style="list-style-type: none"> • Precision Mechanics • Imaging Systems • AI for diagnostics 	<ul style="list-style-type: none"> • Precision Mechanics: Expertise in designing precise and reliable mechanical systems. • Imaging Systems: Knowledge of medical imaging technologies. • Robotic Surgery: Understanding of robotic-assisted surgical procedures. • Software Development: Skills in developing software for real-time control and monitoring. • Regulatory Compliance: Familiarity with medical device regulations and standards. 	<ul style="list-style-type: none"> • Surgical Robots • Rehabilitation Robots • Robotic Prosthetics • Diagnostic Robots 	<ul style="list-style-type: none"> • Intuitive Surgical (da Vinci): Develops surgical robots • Stryker: Specializes in medical and surgical robotics • Medtronic
MILITARY AND DEFENSE ROBOTICS	Use of robotics for defense and military purposes	<ul style="list-style-type: none"> • UAVs (Unmanned Aerial Vehicles) • UGVs (Unmanned Ground Vehicles) • robotics for explosive ordnance disposal 	<ul style="list-style-type: none"> • Autonomous Systems: Expertise in developing autonomous vehicles and drones. • Control Systems: Understanding of advanced control systems for unmanned vehicles. • Sensors and Surveillance: Knowledge of surveillance technologies and sensors. • Robustness and Reliability: Ability to design systems that operate in harsh environments. • Cybersecurity: Skills to ensure the security of robotic systems. 	<ul style="list-style-type: none"> • Surveillance • Bomb Disposal • Logistics • Autonomous Vehicles 	<ul style="list-style-type: none"> • Boston Dynamics: Develops advanced robotic systems for defense • Northrop Grumman: Specializes in defense and aerospace robotics • QinetiQ
AGRICULTURAL ROBOTICS	Automation in agriculture to increase efficiency and productivity	<ul style="list-style-type: none"> • Autonomous Tractors • Drones • Robotic Harvesters 	<ul style="list-style-type: none"> • Autonomous Navigation: Experience with GPS and other navigation systems. • Robotic Harvesting: Knowledge of robotic systems for planting and harvesting. • Sensor Integration: Skills in integrating sensors for crop monitoring. • Machine Learning: Application of machine learning for precision farming. • Mechanical Design: Ability to design robust agricultural machinery. 	<ul style="list-style-type: none"> • Planting • Harvesting • Weeding • Monitoring Crops and Livestock 	<ul style="list-style-type: none"> • John Deere: Develops autonomous tractors. • Blue River Technology: Specializes in precision agriculture robotics. • Agrobot
SPACE ROBOTICS	Robotics for space exploration and operations.	<ul style="list-style-type: none"> • Autonomous Navigation • Robust Communication Systems • Extreme Environment Handling 	<ul style="list-style-type: none"> • Autonomous Navigation: Expertise in autonomous navigation and path planning. • Robust Design: Ability to design systems that can operate in extreme environments. • Teleoperation: Skills in remote operation of robotic systems. • System Integration: Integrating various subsystems (mechanical, electrical, software). • Scientific Research: Knowledge of scientific instruments and data collection methods. 	<ul style="list-style-type: none"> • Planetary Rovers • Robotic Arms For Satellite Servicing • Space Station Maintenance 	<ul style="list-style-type: none"> • NASA's Mars Rovers • Canadarm • European Space Agency (ESA) Robots

HUMANOID ROBOTICS	Development of robots that mimic human form and capabilities	<ul style="list-style-type: none"> • Artificial Intelligence • Advanced Sensors • Complex Mechanical Design 	<ul style="list-style-type: none"> • Artificial Intelligence: Proficiency in AI and machine learning. • Human-Robot Interaction: Designing interfaces for intuitive interaction with humans. • Motion Planning: Skills in motion planning and control. • Mechanical Design: Designing complex mechanical systems that mimic human movements. • Speech and Vision: Knowledge of natural language processing and computer vision. 	<ul style="list-style-type: none"> • Research • Entertainment • Personal Assistants • Healthcare 	<ul style="list-style-type: none"> • Honda (ASIMO): Develops humanoid robots • SoftBank Robotics (Pepper): Creates social robots
SWARM ROBOTICS	Coordination of large numbers of simple robots to achieve complex tasks	<ul style="list-style-type: none"> • Distributed Algorithms • Communication Protocols • Collective Behavior Models 	<ul style="list-style-type: none"> • Distributed Algorithms: Knowledge of algorithms for distributed systems. • Communication Protocols: Understanding of communication technologies for robot-to-robot communication. • Collective Behavior: Expertise in modeling and programming collective behaviors. • Sensor Networks: Skills in deploying and managing sensor networks. • Simulation: Ability to simulate large-scale swarm systems. 	<ul style="list-style-type: none"> • Search and Rescue • Environmental Monitoring • Agriculture 	<ul style="list-style-type: none"> • Harvard's Kilobots: Research in swarm robotics • University of Sheffield: Projects in swarm robotics
AUTONOMOUS VEHICLES	Development of self-driving cars and other autonomous transport systems	<ul style="list-style-type: none"> • Machine Learning • Computer Vision • Sensor Fusion • Navigation Systems 	<ul style="list-style-type: none"> • Machine Learning: Application of ML algorithms for vehicle perception and decision-making. • Computer Vision: Proficiency in computer vision for object detection and classification. • Sensor Fusion: Integrating data from various sensors (LiDAR, radar, cameras). • Navigation Systems: Skills in GPS and other navigation technologies. • Software Development: Programming in C++, Python, and ROS. 	<ul style="list-style-type: none"> • Passenger Transport • Logistics • Industrial Transport 	<ul style="list-style-type: none"> • Waymo: Develops autonomous cars • Tesla: Focuses on self-driving technology
EDUCATIONAL ROBOTICS	Robotics for education and STEM learning	<ul style="list-style-type: none"> • Simple Programming Interfaces • Modular Robotics Kits 	<ul style="list-style-type: none"> • STEM Education: Knowledge of STEM concepts and educational techniques. • Programming: Skills in block-based and text-based programming languages. • Curriculum Development: Ability to develop educational content and curricula. • Hands-on Skills: Experience with educational robotics kits and platforms. • Teaching: Effective teaching and mentoring skills. 	<ul style="list-style-type: none"> • Educational Kits • Coding Platforms • Competitions 	<ul style="list-style-type: none"> • LEGO Mindstorms: Educational robotics kits • VEX Robotics: Platforms for robotics education and competitions