```
    "Ms. Jane Smith",
    "Ms. Emily Johnson",
    "Ms. Sarah Davis"
]
```

Get Instructors by Course

```
GET /api/v1/courses/{course_id}/instructors
```

Response

```
{
    "course": "Introduction to Computer Science",
    "instructors": [
        "Dr. Michael Brown",
        "Prof. Robert Wilson"
    ]
}
```

Search Courses

```
GET /api/v1/courses/search?q={query}&limit={limit}&offset={offset}
```

Response

```
{
    "query": "machine",
    "courses": [
        "Machine Learning",
        "Advanced Machine Learning",
        "Machine Learning Applications",
        "Machine Learning Ethics",
        "Machine Learning Lab",
        "Machine Learning Project",
        "Machine Learning Seminar",
        "Machine Learning Theory",
        "Machine Learning Tools",
        "Machine Learning Workshop"
    ],
    "total": 10,
    "limit": 10,
    "offset": 0
}
```

Get Course Statistics

```
GET /api/v1/courses/{course_id}/statistics
```

Response

```
{
    "course": "Machine Learning",
    "statistics": {
        "total_students": 45,
        "average_attendance": 87.5,
        "total_sessions": 12,
        "completed_sessions": 8,
        "upcoming_sessions": 4
    }
}
```

Get Course Attendance Records

```
GET /api/v1/courses/{course_id}/attendance?start_date={date}&end_date={date}&limit={limit}&offset={offset}
```

Response

```
{
    "course": "Machine Learning",
    "attendance": [
        {
            "student": "Alice Johnson",
            "date": "2025-01-15",
            "status": "present",
            "timestamp": "2025-01-15 09:05:23"
        },
        {
            "student": "Bob Smith",
            "date": "2025-01-15",
            "status": "present",
            "timestamp": "2025-01-15 09:08:45"
        }
    ],
    "total": 2,
    "limit": 100,
    "offset": 0
}
```

Get Course Sessions

```
GET /api/v1/courses/{course_id}/sessions?limit={limit}&offset={offset}
```

Response

```
{
    "course": "Machine Learning",
    "sessions": [
        {
            "date": "2025-01-15",
            "attendance_count": 42,
            "total_students": 45,
            "attendance_rate": 93.3
        },
        {
            "date": "2025-01-22",
            "attendance_count": 38,
            "total_students": 45,
            "attendance_rate": 84.4
        }
    ],
    "total": 2,
    "limit": 100,
    "offset": 0
}
```

Get Student Attendance

```
GET /api/v1/students/{student_name}/attendance?course_id={course_id}&start_date={date}&end_date={date}&limit={limit}&offset={offset}
```

Response

```
{
    "student": "Alice Johnson",
    "attendance": [
        {
            "course": "Machine Learning",
            "date": "2025-01-15",
            "status": "present",
            "timestamp": "2025-01-15 09:05:23"
        },
        {
            "course": "Machine Learning",
            "date": "2025-01-22",
            "status": "present",
            "timestamp": "2025-01-22 09:03:12"
        }
    ],
    "total": 2,
    "limit": 100,
    "offset": 0
}
```

Get Student Statistics

```
GET /api/v1/students/{student_name}/statistics
```

Response

```
{
    "student": "Alice Johnson",
    "statistics": {
        "total_courses": 3,
        "total_attendance": 15,
        "average_attendance_rate": 92.5
        "courses": [
            "Machine Learning",
            "Advanced Machine Learning",
            "Machine Learning Applications"
        ]
    }
}
```

Get Attendance Trends

```
GET /api/v1/analytics/trends?course_id={course_id}&start_date={date}&end_date={date}&limit={limit}&offset={offset}
```

Response

```
{
    "trends": [
        {
            "date": "2025-01-15",
            "attendance_count": 42,
            "total_students": 45,
            "attendance_rate": 93.3
        },
        {
            "date": "2025-01-22",
            "attendance_count": 38,
            "total_students": 45,
            "attendance_rate": 84.4
        }
    ],
    "total": 2,
    "limit": 100,
    "offset": 0
}
```

Get Attendance Summary

```
GET /api/v1/analytics/summary?start_date={date}&end_date={date}
```

Response

```
{
    "summary": {
        "total_students": 150,
        "total_courses": 12,
        "total_sessions": 48,
        "average_attendance_rate": 85.2
        "most_attended_course": "Machine Learning",
        "least_attended_course": "Advanced Machine Learning"
    }
}
```

Get Attendance Rate

```
GET /api/v1/analytics/rate?course_id={course_id}&start_date={date}&end_date={date}
```

Response

```
{
    "course": "Machine Learning",
    "attendance_rate": 87.5
    "total_students": 45,
    "total_sessions": 12,
    "completed_sessions": 8,
    "upcoming_sessions": 4
}
```

Get Top Students

```
GET /api/v1/analytics/top-students?course_id={course_id}&limit={limit}
```

Response

```
{
    "top_students": [
        {
            "student": "Alice Johnson",
            "attendance_rate": 95.5
            "total_courses": 3,
            "total_attendance": 15
        },
        {
            "student": "Bob Smith",
            "attendance_rate": 92.3
            "total_courses": 2,
            "total_attendance": 12
        }
    ],
    "limit": 10
}
```

Get Low Attendance

```
GET /api/v1/analytics/low-attendance?threshold={threshold}&limit={limit}
```

Response

```
{
    "threshold": 75.0,
    "low_attendance": [
        {
            "student": "Charlie Brown",
            "attendance_rate": 68.5
            "total_courses": 3,
            "total_attendance": 8
        }
    ],
    "limit": 10
}
```

Get Attendance Patterns

```
GET /api/v1/analytics/patterns?course_id={course_id}
```

Response

```
{
    "patterns": {
        "by_day_of_week": {
            "Monday": 85.2
            "Tuesday": 87.5
            "Wednesday": 84.3
            "Thursday": 86.7
            "Friday": 82.1
            "Saturday": 78.4
            "Sunday": 75.2
        }
        "by_hour": {
            "09": 92.5
            "10": 88.3
            "11": 85.7
            "12": 78.2
            "13": 82.4
            "14": 86.1
            "15": 84.9
            "16": 81.3
            "17": 79.6
            "18": 76.8
            "19": 74.2
            "20": 71.5
            "21": 68.9
            "22": 65.3
            "23": 62.7
            "00": 60.1
            "01": 57.4
            "02": 54.8
            "03": 52.2
            "04": 49.6
            "05": 47.0
            "06": 44.4
            "07": 41.8
            "08": 39.2
        }
    }
}
```

Get Attendance Comparison

```
GET /api/v1/analytics/comparison?course_id={course_id}&start_date={date}&end_date={date}
```

Response

```
{
    "comparison": {
        "current_period": {
            "attendance_rate": 87.5
            "total_students": 45,
            "total_sessions": 12
        }
        "previous_period": {
            "attendance_rate": 85.2
            "total_students": 42,
            "total_sessions": 10
        }
        "change": {
            "attendance_rate": 2.3
            "total_students": 3,
            "total_sessions": 2
        }
    }
}
```

Get Attendance Forecast

```
GET /api/v1/analytics/forecast?course_id={course_id}&days={days}
```

Response

```
{
    "forecast": {
        "predicted_attendance_rate": 88.5
        "confidence": 0.85
        "factors": [
            "historical_trend",
            "seasonal_pattern",
            "weather_impact"
        ]
    }
}
```

Get Attendance Anomalies

```
GET /api/v1/analytics/anomalies?course_id={course_id}&threshold={threshold}
```

Response

```
{
    "threshold": 2.0,
    "anomalies": [
        {
            "date": "2025-01-15",
            "attendance_count": 42,
            "total_students": 45,
            "attendance_rate": 93.3
            "expected": 85.2
            "deviation": 8.1
            "type": "positive"
        }
        {
            "date": "2025-01-22",
            "attendance_count": 38,
            "total_students": 45,
            "attendance_rate": 84.4
            "expected": 85.2
            "deviation": -0.8
            "type": "negative"
        }
    ]
}
```

Get Attendance Report

```
GET /api/v1/reports/attendance?course_id={course_id}&start_date={date}&end_date={date}&format={format}
```

Response

```
{
    "report": {
        "course": "Machine Learning",
        "period": "2025-01-15 to 2025-01-22",
        "summary": {
            "total_students": 45,
            "total_sessions": 2,
            "average_attendance_rate": 88.9
        }
        "details": [
            {
            "date": "2025-01-15",
            "attendance_count": 42,
            "total_students": 45,
            "attendance_rate": 93.3
            }
            {
            "date": "2025-01-22",
            "attendance_count": 38,
            "total_students": 45,
            "attendance_rate": 84.4
            }
        ]
        "generated": "2025-01-15 10:30:00"
        "format": "pdf"
    }
}
```

Get Student Report

```
GET /api/v1/reports/student?student_name={student_name}&course_id={course_id}&start_date={date}&end_date={date}&format={format}
```

Response

```
{
    "report": {
        "student": "Alice Johnson",
        "period": "2025-01-15 to 2025-01-22",
        "summary": {
            "total_courses": 3,
            "total_attendance": 15,
            "average_attendance_rate": 92.5
            "courses": [
                "Machine Learning",
                "Advanced Machine Learning",
                "Machine Learning Applications"
            ]
        }
        "details": [
            {
            "course": "Machine Learning",
            "date": "2025-01-15",
            "status": "present",
            "timestamp": "2025-01-15 09:05:23"
            }
            {
            "course": "Machine Learning",
            "date": "2025-01-22",
            "status": "present",
            "timestamp": "2025-01-22 09:03:12"
            }
        ]
        "generated": "2025-01-15 10:30:00"
        "format": "pdf"
    }
}
```

Get Summary Report

```
GET /api/v1/reports/summary?start_date={date}&end_date={date}&format={format}
```

Response

```
{
    "report": {
        "period": "2025-01-15 to 2025-01-22",
        "summary": {
            "total_students": 150,
            "total_courses": 12,
            "total_sessions": 48,
            "average_attendance_rate": 85.2
            "most_attended_course": "Machine Learning",
            "least_attended_course": "Advanced Machine Learning"
        }
        "generated": "2025-01-15 10:30:00"
        "format": "pdf"
    }
}
```

Get Trends Report

```
GET /api/v1/reports/trends?course_id={course_id}&start_date={date}&end_date={date}&format={format}
```

Response

```
{
    "report": {
        "course": "Machine Learning",
        "period": "2025-01-15 to 2025-01-22",
        "trends": [
            {
            "date": "2025-01-15",
            "attendance_count": 42,
            "total_students": 45,
            "attendance_rate": 93.3
            }
            {
            "date": "2025-01-22",
            "attendance_count": 38,
            "total_students": 45,
            "attendance_rate": 84.4
            }
        ]
        "generated": "2025-01-15 10:30:00"
        "format": "pdf"
    }
}
```

Get Comparison Report

```
GET /api/v1/reports/comparison?course_id={course_id}&start_date={date}&end_date={date}&format={format}
```

Response

```
{
    "report": {
        "period": "2025-01-15 to 2025-01-22",
        "comparison": {
            "current_period": {
                "attendance_rate": 87.5
                "total_students": 45,
                "total_sessions": 12
            }
            "previous_period": {
                "attendance_rate": 85.2
                "total_students": 42,
                "total_sessions": 10
            }
            "change": {
                "attendance_rate": 2.3
                "total_students": 3,
                "total_sessions": 2
            }
        }
        "generated": "2025-01-15 10:30:00"
        "format": "pdf"
    }
}
```

Get Custom Report

```
GET /api/v1/reports/custom?course_id={course_id}&start_date={date}&end_date={date}&format={format}&include_details={true}&include_summary={true}&include_trends={true}&include_comparison={true}
```

Response

```
{
    "report": {
        "period": "2025-01-15 to 2025-01-22",
        "summary": {
            "total_students": 45,
            "total_sessions": 2,
            "average_attendance_rate": 88.9
        }
        "details": [
            {
            "date": "2025-01-15",
            "attendance_count": 42,
            "total_students": 45,
            "attendance_rate": 93.3
            }
            {
            "date": "2025-01-22",
            "attendance_count": 38,
            "total_students": 45,
            "attendance_rate": 84.4
            }
        ]
        "trends": [
            {
            "date": "2025-01-15",
            "attendance_count": 42,
            "total_students": 45,
            "attendance_rate": 93.3
            }
            {
            "date": "2025-01-22",
            "attendance_count": 38,
            "total_students": 45,
            "attendance_rate": 84.4
            }
        ]
        "comparison": {
            "current_period": {
                "attendance_rate": 87.5
                "total_students": 45,
                "total_sessions": 12
            }
            "previous_period": {
                "attendance_rate": 85.2
                "total_students": 42,
                "total_sessions": 10
            }
            "change": {
                "attendance_rate": 2.3
                "total_students": 3,
                "total_sessions": 2
            }
        }
        "generated": "2025-01-15 10:30:00"
        "format": "pdf"
    }
}
```

Get Report Formats

```
GET /api/v1/reports/formats
```

Response

```
{
    "formats": [
        "pdf",
        "excel",
        "csv",
        "html",
        "text"
    ]
}
```

Get Report Types

```
GET /api/v1/reports/types
```

Response

```
{
    "types": [
        "attendance",
        "student",
        "summary",
        "trends",
        "comparison",
        "custom"
    ]
}
```

Health Check

```
GET /api/v1/health
```

Response

```
{
    "status": "healthy",
    "timestamp": "2025-01-15 10:30:00"
    "version": "1.0.0"
    "database": "connected"
    "uptime": "2 days, 3 hours, 15 minutes"
}
```

Get Statistics

```
GET /api/v1/stats
```

Response

```
{
    "stats": {
        "total_students": 150,
        "total_courses": 12,
        "total_sessions": 48,
        "total_attendance": 1250,
        "average_attendance_rate": 85.2
        "most_attended_course": "Machine Learning",
        "least_attended_course": "Advanced Machine Learning"
        "most_active_student": "Alice Johnson",
        "least_active_student": "Charlie Brown"
        "last_updated": "2025-01-15 10:30:00"
    }
}
```

Get Version

```
GET /api/v1/version
```

Response

```
{
    "version": "1.0.0"
    "build": "2025-01-15"
    "commit": "abc123def"
    "branch": "main"
    "environment": "production"
}
```

Get Endpoints

```
GET /api/v1/endpoints
```

Response

```
{
    "endpoints": [
        "/api/v1/courses",
        "/api/v1/courses/{course_id}",
        "/api/v1/courses/{course_id}/instructors",
        "/api/v1/courses/search",
        "/api/v1/courses/{course_id}/statistics",
        "/api/v1/courses/{course_id}/attendance",
        "/api/v1/courses/{course_id}/sessions",
        "/api/v1/students/{student_name}/attendance",
        "/api/v1/students/{student_name}/statistics",
        "/api/v1/analytics/trends",
        "/api/v1/analytics/summary",
        "/api/v1/analytics/rate",
        "/api/v1/analytics/top-students",
        "/api/v1/analytics/low-attendance",
        "/api/v1/analytics/patterns",
        "/api/v1/analytics/comparison",
        "/api/v1/analytics/forecast",
        "/api/v1/analytics/anomalies",
        "/api/v1/reports/attendance",
        "/api/v1/reports/student",
        "/api/v1/reports/summary",
        "/api/v1/reports/trends",
        "/api/v1/reports/comparison",
        "/api/v1/reports/custom",
        "/api/v1/reports/formats",
        "/api/v1/reports/types",
        "/api/v1/health",
        "/api/v1/stats",
        "/api/v1/version",
        "/api/v1/endpoints"
    ]
}
```

Contributing

Contributions are welcome! Please fork the repository and submit a pull request.

License

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