```
pragma solidity ^0.8.0;

contract StudentRegistry {
    struct Student {
        string name;
        uint256 age;
        string class;
        uint256 rollNumber;
    }

    // Array to store students
    Student[] private students;

    // Function to add a new student
    function addStudent (
        string memory name,
        uint256 age,
        string memory class,
        uint256 rollNumber
    ) payable public {
        students.push(Student(name, age, class, rollNumber));
    }

    // Function to retrieve a student by index
    function getStudent(uint256 index) public view returns (
        string memory,
        uint256,
        string memory,
        uint256
    ) {
```

```
        require(index < students.length, "Student not found");
        Student memory student = students[index];
        return (student.name, student.age, student.class, student.rollNumber);
    }

    // Function to get the total count of students
    function getStudentCount() public view returns (uint256) {
        return students.length;
    }

    // Fallback function to handle unexpected transactions or function calls
    fallback() external payable {
        // Can leave it empty or add a custom logic if required
    }

    // Optional: You can also include a receive function to handle direct Ether transfers
    receive() external payable {}
}
```

/*

This Solidity code defines a StudentRegistry smart contract, which stores student information and demonstrates several important Solidity concepts. I'll go through each section and its relevant Solidity theory.

SPDX License Identifier

solidity

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// SPDX-License-Identifier: Bhide License

- The SPDX license identifier specifies the software license associated with the code.

- Including this comment at the top of the file is a good practice, especially in open-source development, to inform users and the compiler about the licensing.

Pragma Directive

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```
pragma solidity ^0.8.0;
```

- The pragma solidity ^0.8.0; directive tells the compiler that this code should be compiled with version 0.8.0 or newer but not breaking version 0.9.0.
- It helps ensure that the contract is compatible with specific Solidity features and security enhancements introduced in version 0.8.0.

Contract Declaration

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```
contract StudentRegistry {
    ...
}
```

- **Contracts**: In Solidity, a contract is similar to a class in object-oriented programming. It encapsulates code (functions) and data (state variables).
- The contract is named StudentRegistry, and it will be deployed to the Ethereum blockchain. Once deployed, it can be interacted with by users or other contracts.

Structures (Structs)

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```
struct Student {
    string name;
    uint256 age;
    string class;
    uint256 rollNumber;
}
```

- **Structs**: A struct in Solidity is a custom data type that groups multiple variables under one name. This helps organize related data. In this case, the Student struct represents a student's information.
- **Data Types**:

- string name: Stores the student’s name as a text string.
- uint256 age: Stores the age as an unsigned integer (uint256 can store values from 0 to 2^256 - 1).
- string class: Stores the class or grade of the student.
- uint256 rollNumber: Stores a unique roll number for the student.

This structure is essential for storing each student's unique details in a single organized format.

State Variables

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```
Student[] private students;
```

- **Arrays**: Solidity arrays are data structures that hold a sequence of elements of the same type. Here, Student[] is a dynamic array, meaning its length can change.
- **Visibility Modifier**: The private keyword limits access to the students array, meaning only functions within StudentRegistry can access it. This keeps the student records secure and limits data exposure.

addStudent Function

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```
function addStudent(
    string memory name,
    uint256 age,
    string memory class,
    uint256 rollNumber
) public {
    students.push(Student(name, age, class, rollNumber));
}
```

- **Function Declaration**: Functions in Solidity perform actions. Here, addStudent allows users to add a new student’s data to the students array.
- **Parameters**:
    - The parameters (name, age, class, rollNumber) allow the user to specify the values for each field in the Student struct.
    - memory is used as the data location for the string types name and class. memory is a temporary storage area in Solidity that exists only while the function executes, unlike storage (which is persistent on the blockchain).

- **Visibility Modifier (public)**: Declaring a function public makes it accessible to anyone on the blockchain, allowing external users to call it.
- **Array Push**: students.push(...) appends a new Student to the students array. It uses the Student struct constructor syntax to create a new struct with the provided parameters.

getStudent Function

solidity

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```
function getStudent(uint256 index) public view returns (
    string memory,
    uint256,
    string memory,
    uint256
) {
    require(index < students.length, "Student not found");
    Student memory student = students[index];
    return (student.name, student.age, student.class, student.rollNumber);
}
```

- **Purpose**: This function retrieves the details of a student from the students array based on the provided index.
- **View Modifier**: The view modifier indicates that the function does not alter the contract's state; it only reads data. View functions do not consume gas if called from an external account, as they do not modify the blockchain.
- **Returns Clause**: returns (...) specifies the types of values this function will return: two string types and two uint256 values.
- **require Statement**: require(index < students.length, "Student not found"); checks if the provided index is valid. If not, it reverts the transaction with the message "Student not found."
- **Memory Keyword**: Using memory for the student variable specifies that it's a temporary copy of the struct data.
- **Return Statement**: The function returns the requested student's details, including name, age, class, and roll number.

getStudentCount Function

solidity

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```
function getStudentCount() public view returns (uint256) {
    return students.length;
}
```

- **Purpose**: getStudentCount returns the total number of students stored in the contract.
- **Visibility Modifier (public)**: This function is public, so anyone can access it.
- **View Modifier**: As it only reads the students.length, it is marked view.
- **Return Statement**: It returns the length of the students array, which represents the total count of students.

Fallback Function

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```
fallback() external payable {
    // Can leave it empty or add a custom logic if required
}
```

- **Purpose**: The fallback function is a special function in Solidity that is called when an invalid function call is made or when Ether is sent to the contract without any function specified.
- **External Visibility**: external restricts access to calls from outside the contract.
- **Payable Modifier**: payable allows the function to accept Ether transfers, meaning the contract can receive funds from users.
- **Logic**: This fallback function can be left empty if no action is needed upon receiving unexpected transactions.

Receive Function (Optional)

solidity

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```
receive() external payable {}
```

- **Purpose**: The receive() function is an optional function that, if defined, is triggered when Ether is sent to the contract without any function call or data.
- **External and Payable Modifiers**: As with fallback(), receive() must be external and payable.
- **Use**: This function can be useful if you want to handle direct Ether transfers differently from other transactions.

Key Solidity Concepts Used in This Contract

1. **Structs**: Group related data types together, making it easier to handle complex data like student records in a single, organized format.

2. **Dynamic Arrays**: Used to store an expandable list of elements, allowing the contract to handle a variable number of students.
3. **Visibility Modifiers**:
    - public: Allows anyone to call the function.
    - private: Restricts access to only functions within the contract.
    - view: Specifies that a function only reads data and doesn't modify the blockchain.
4. **Fallback and Receive Functions**:
    - Fallback functions handle invalid function calls or Ether transfers with unexpected data.
    - Receive functions handle Ether transfers sent without data.
5. **Data Locations (memory and storage)**:
    - memory: Temporary storage, cleared after the function execution.
    - storage: Permanent storage on the blockchain, used for state variables like students.
6. **require Statements**: require checks conditions and reverts transactions with an error message if the condition fails. It's used for validation to ensure code only executes if certain conditions are met.
7. **Gas and Transaction Fees**:
    - Each transaction on Ethereum consumes gas, a unit of computational effort. Functions that modify the blockchain, like addStudent, incur gas costs.
    - view functions don't consume gas when called externally, as they don't alter the blockchain state.

Observing Gas and Transaction Fees

1. **Deploy the Contract**: Deploy the contract on the Ethereum network using a tool like Remix or a local blockchain setup.
2. **Execute Functions**: Perform operations, like adding students and retrieving details, to see how much gas each transaction uses.
3. **View Gas Fees**: The gas fee displayed after each transaction shows how much Ether was spent on computational resources for that transaction.

This contract demonstrates foundational Solidity principles and enables users to interact with a simple student registry on the Ethereum blockchain.

*/