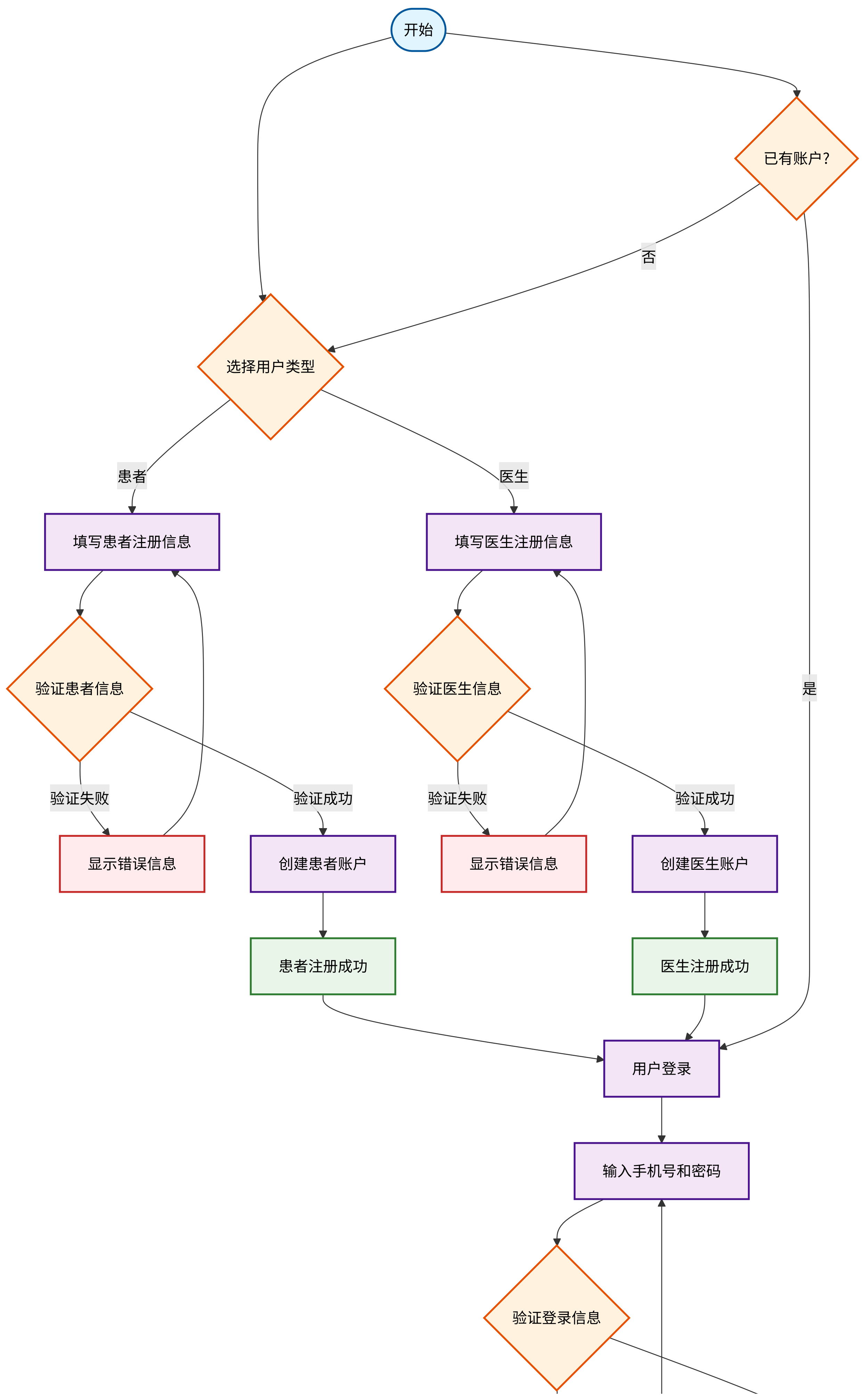
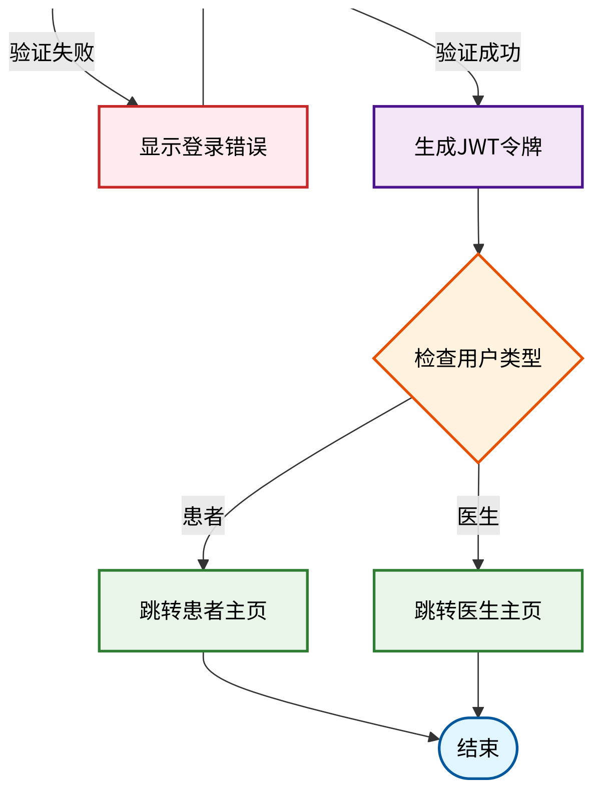
活动图

1. 用户注册和登录流程


开始
已有账户?
否
是
选择用户类型
患者
医生
填写患者注册信息
填写医生注册信息
验证患者信息
验证医生信息
验证失败
验证成功
验证失败
验证成功
显示错误信息
创建患者账户
显示错误信息
创建医生账户
患者注册成功
医生注册成功
用户登录
输入手机号和密码
验证登录信息



业务流程说明

这个流程图展示了医疗系统中患者和医生的注册登录流程。系统支持两种用户类型的注册，通过手机号格式验证确保数据完整性。

关键技术实现

用户模型设计 (models.py):

```
class PatientModel(db.Model):
    __tablename__ = 'patient'
    id = db.Column(db.Integer, primary_key=True, autoincrement=True)
    phone = db.Column(db.String(11), nullable=False, unique=True)
    name = db.Column(db.String(50), nullable=False)
    password = db.Column(db.String(50), nullable=False)
    create_time = db.Column(db.DateTime, nullable=False, default=datetime.now)
    update_time = db.Column(db.DateTime, nullable=False, default=datetime.now,
onupdate=datetime.now)

class DoctorModel(db.Model):
    __tablename__ = 'doctor'
    id = db.Column(db.Integer, primary_key=True, autoincrement=True)
    phone = db.Column(db.String(11), nullable=False, unique=True)
    name = db.Column(db.String(50), nullable=False)
    password = db.Column(db.String(50), nullable=False)
    create_time = db.Column(db.DateTime, nullable=False, default=datetime.now)
    update_time = db.Column(db.DateTime, nullable=False, default=datetime.now,
onupdate=datetime.now)
```

手机号验证功能 (utils.py):

```
def validate_phone_number(phone):
    """简化版手机号验证（仅限国内）"""
    pattern = r'^1[3-9]\d{9}$'  # 严格的11位国内手机号
    return re.match(pattern, phone) is not None
```

统一响应格式 (utils.py):

```
class Result:
    def __init__(self, code, msg, data):
        self.code = code
        self.msg = msg
        self.data = data

    @staticmethod
    def success(data=None):
        return Result(1, "", data)

    @staticmethod
    def error(msg):
        return Result(0, msg, None)
```

登录视图对象 (vo.py):

```
class LoginVO:
    def __init__(self, id, name, role, token, avatar_url):
        self.id = id
        self.name = name
        self.role = role
        self.token = token
        self.avatar_url = avatar_url
    def to_dict(self):
        return {"id": self.id, "name": self.name, "role": self.role,
"avatar_url": self.avatar_url, "token": self.token}
```

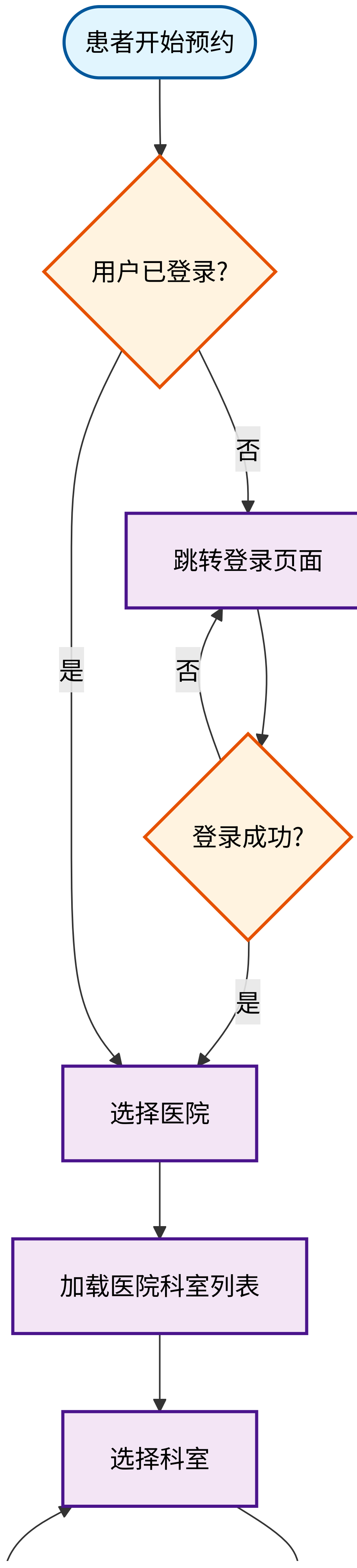
JWT配置 (config.py):

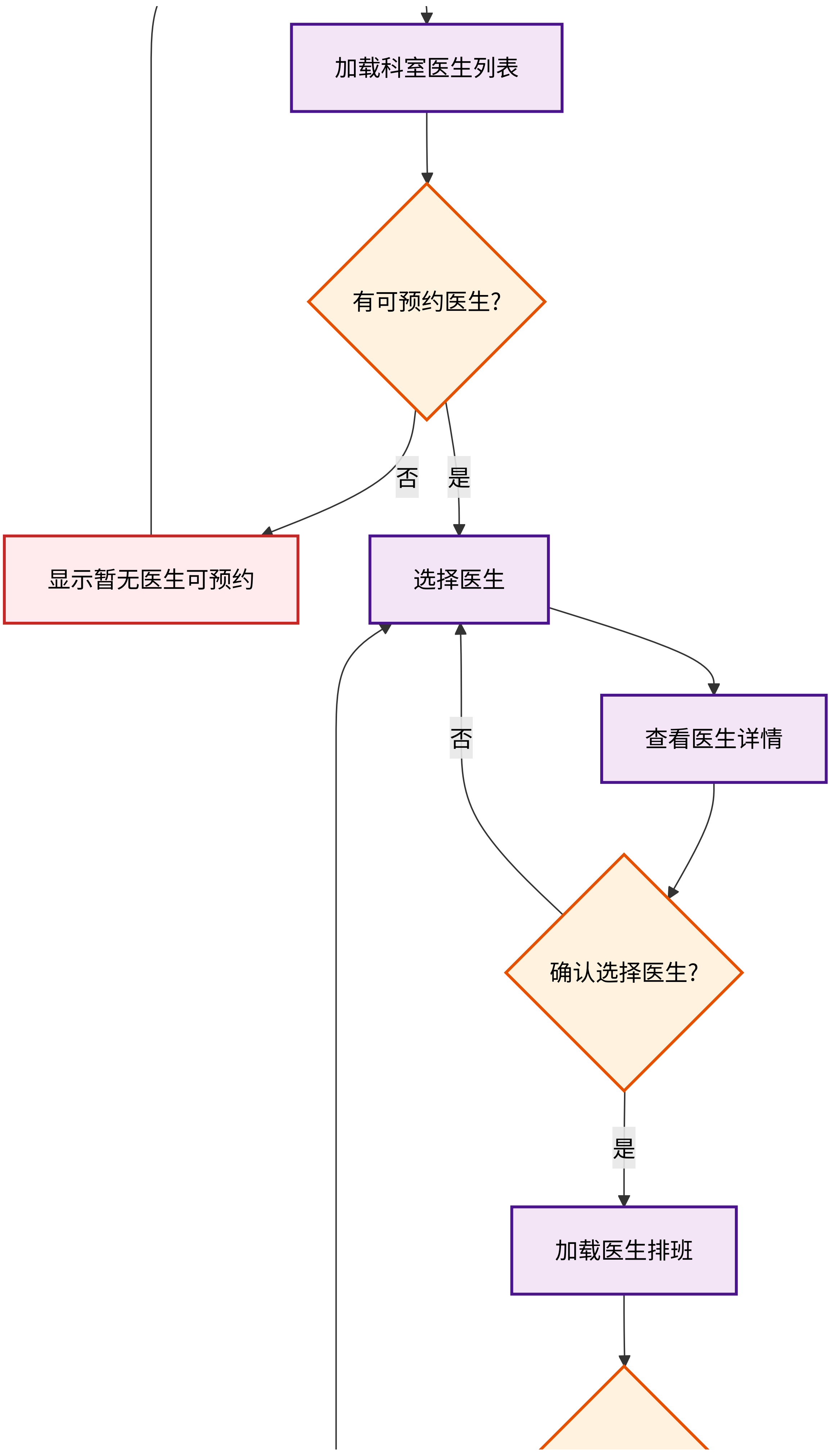
```
class Config:
    JWT_SECRET_KEY = os.getenv('JWT_SECRET_KEY', 'secret string')
    JWT_TOKEN_LOCATION = os.getenv('JWT_TOKEN_LOCATION', 'headers')
    JWT_ACCESS_TOKEN_EXPIRES = int(os.getenv('JWT_ACCESS_TOKEN_EXPIRES', 3600))
 # 1 hour
```

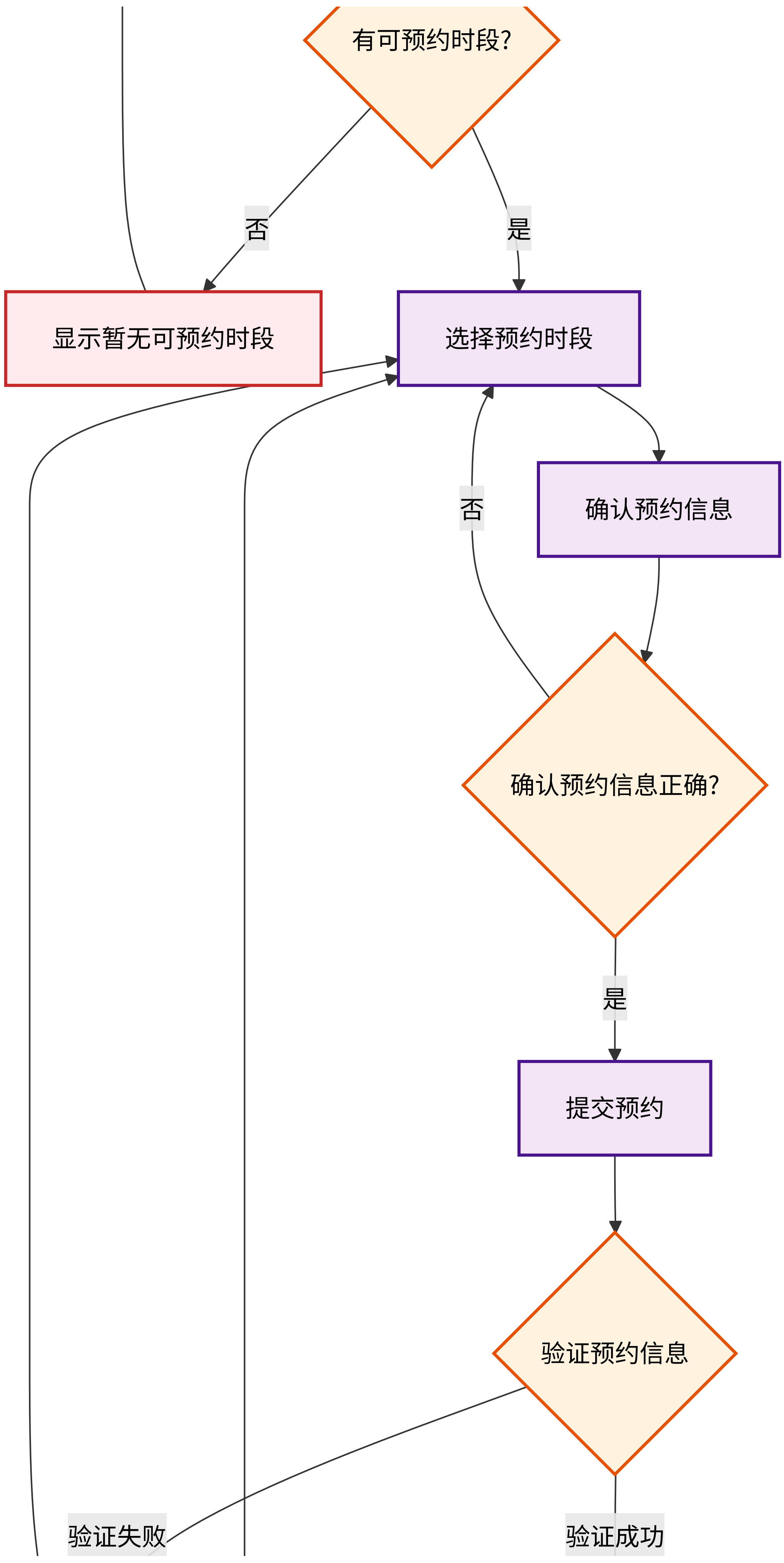
流程特点分析

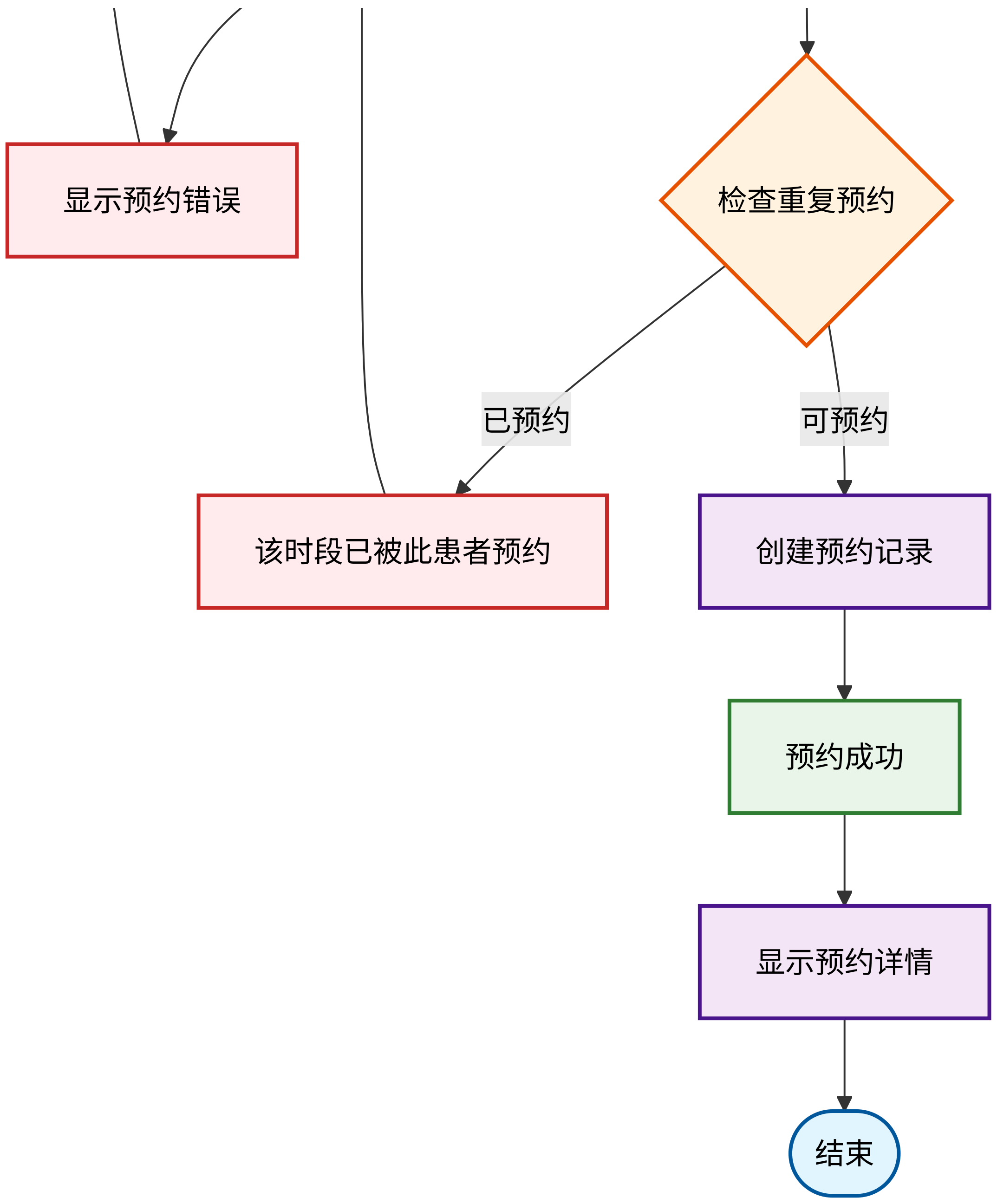
1. **基础验证机制**: 验证基本信息格式，通过手机号格式验证确保数据完整性
2. **用户类型区分**: 患者和医生使用相同的验证流程但创建不同的账户类型
3. **安全性设计**: 密码存储、JWT令牌生成、手机号唯一性约束
4. **错误处理**: 每个验证环节都有对应的错误处理和用户提示

2. 患者预约挂号流程


患者开始预约
用户已登录?
否
是
跳转登录页面
否
登录成功?
是
选择医院
加载医院科室列表
选择科室


加载科室医生列表
有可预约医生?
否
是
显示暂无医生可预约
选择医生
查看医生详情
否
确认选择医生?
是
加载医生排班


有可预约时段?
否
是
显示暂无可预约时段
选择预约时段
确认预约信息
否
确认预约信息正确?
是
提交预约
验证预约信息
验证失败
验证成功



业务流程说明

该流程实现了患者在线预约医生的完整业务逻辑，从医院选择到预约确认，防止重复预约同一医生同一时段。

关键技术实现

医院和科室模型 (models.py):

```
class HospitalModel(db.Model):
    __tablename__ = 'hospital'
    id = db.Column(db.Integer, primary_key=True, autoincrement=True)
    name = db.Column(db.String(100), unique=True, nullable=False)
    departments = db.relationship('DepartmentModel', backref='hospital',
lazy='dynamic')

class DepartmentModel(db.Model):
    __tablename__ = 'department'
    id = db.Column(db.Integer, primary_key=True, autoincrement=True)
    name = db.Column(db.String(50), nullable=False)
    description = db.Column(db.Text)
    hospital_id = db.Column(db.Integer, db.ForeignKey('hospital.id'),
nullable=True)
    doctors = db.relationship('DoctorInfoModel', backref='department',
lazy='dynamic')
```

医生详细信息和排班 (models.py):

```
class DoctorInfoModel(db.Model):
    __tablename__ = 'doctor_info'
    id = db.Column(db.Integer, db.ForeignKey('doctor.id'),primary_key=True)
    hospital_id = db.Column(db.Integer, db.ForeignKey('hospital.id'),
nullable=True)
    department_id = db.Column(db.Integer, db.ForeignKey('department.id'))
    schedule = db.Column(db.JSON, nullable=True, default=lambda: {
        "monday": {"morning": False, "afternoon": False},
        "tuesday": {"morning": False, "afternoon": False},
        "wednesday": {"morning": False, "afternoon": False},
        "thursday": {"morning": False, "afternoon": False},
        "friday": {"morning": False, "afternoon": False}
    })
```

预约挂号模型 (models.py):

```
class RegistrationModel(db.Model):
    __tablename__ = 'registration'
    id = db.Column(db.Integer, primary_key=True, autoincrement=True)
    patient_id = db.Column(db.Integer, db.ForeignKey('patient_info.id'),
nullable=False)
    doctor_id = db.Column(db.Integer, db.ForeignKey('doctor_info.id'),
nullable=False)
    date = db.Column(db.Date, nullable=False, default=datetime.now)
    time_slot = db.Column(db.String(50), nullable=False)  # 时间段，例如
"morning", "afternoon"

    def to_dict(self):
        return {
            "patient": self.patient.name,
            "phone": self.patient.phone,
            "doctor": self.doctor.name,
            "hospital": self.doctor.hospital.name if self.doctor.hospital else
None,
            "department": self.doctor.department.name if self.doctor.department
else None,
            "date": self.date.isoformat(),
            "time_slot": self.time_slot
        }
```

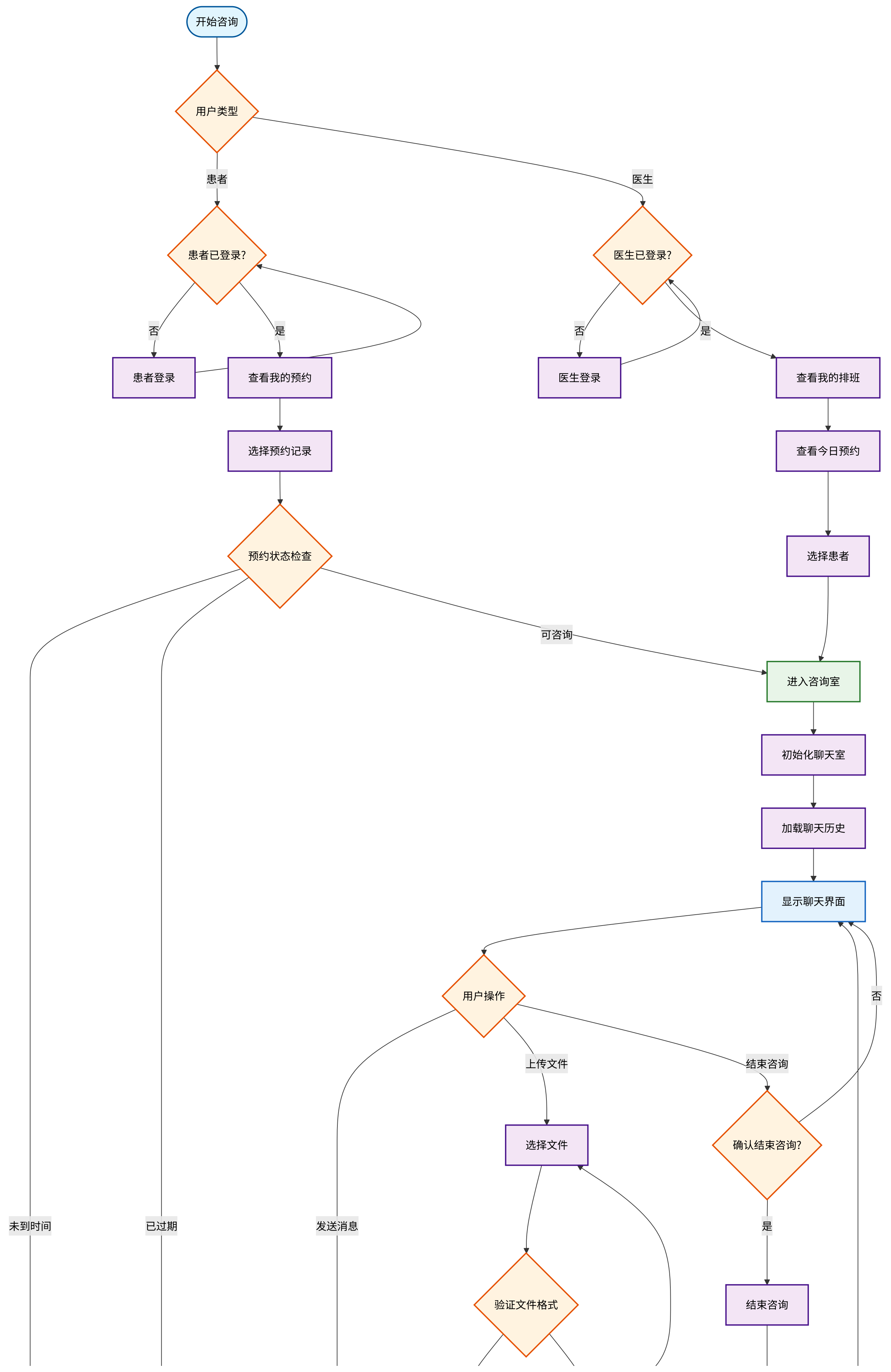
聊天室模型 (models.py):

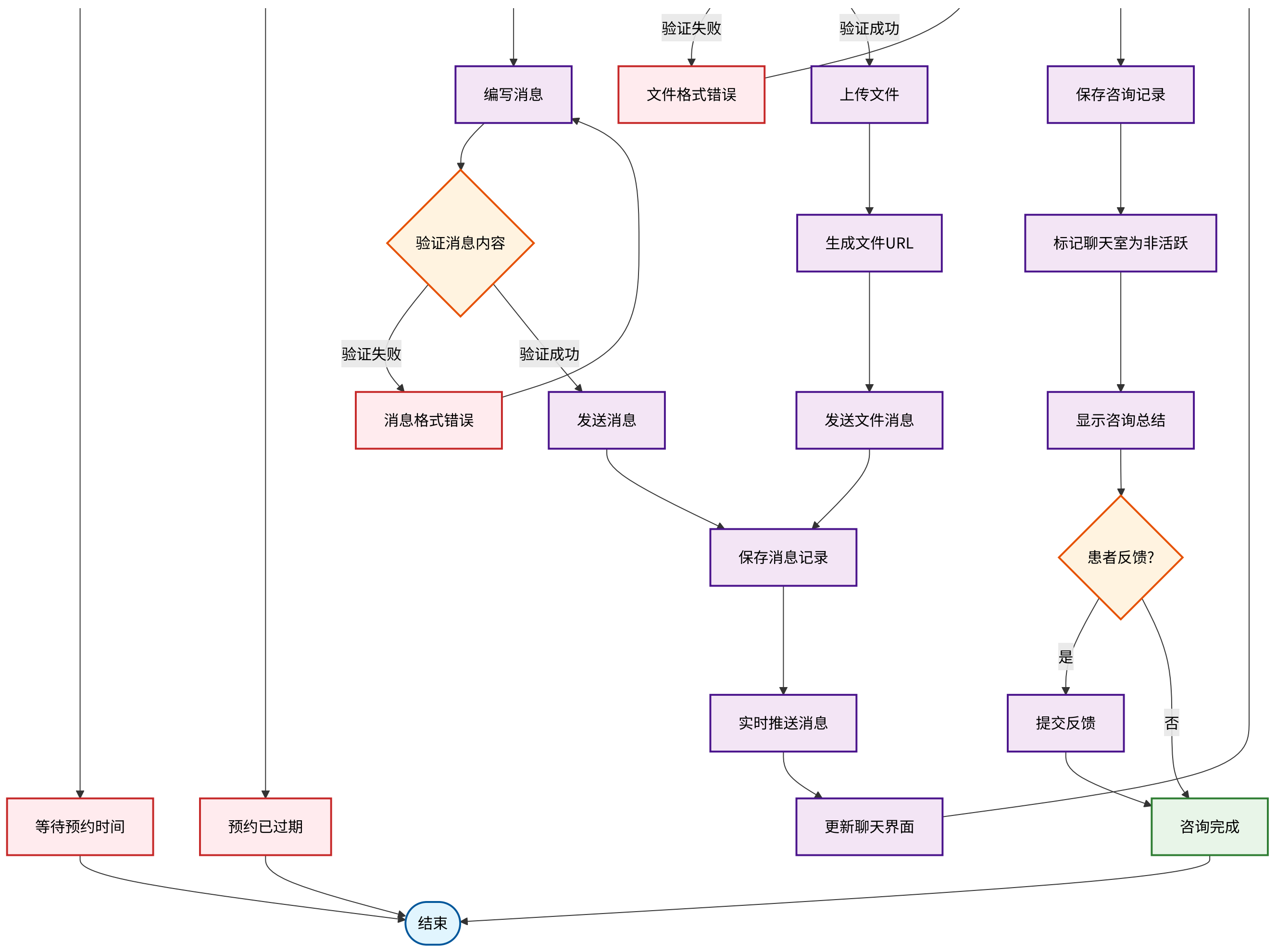
```
class RoomModel(db.Model):
    __tablename__ = 'room'
    id = db.Column(db.Integer, primary_key=True, autoincrement=True)
    doctor_id = db.Column(db.Integer, db.ForeignKey('doctor.id'),
nullable=False)
    patient_id = db.Column(db.Integer, db.ForeignKey('patient.id'),
nullable=False)
```

流程特点分析

1. **层次化选择**: 医院→科室→医生的三级选择结构，符合医疗机构组织架构
2. **实时可用性检查**: 动态加载医生排班信息，确保显示的时段真实可预约
3. **重复预约检测**: 检查患者是否已对同一医生的同一时段进行预约，避免重复预约
4. **简化流程**: 预约成功后直接显示预约详情，医患沟通通过独立的聊天功能实现

3. 医患在线咨询流程


开始咨询
用户类型
患者
医生
患者已登录?
医生已登录?
否
是
否
是
患者登录
查看我的预约
医生登录
查看我的排班
选择预约记录
查看今日预约
预约状态检查
选择患者
可咨询
进入咨询室
初始化聊天室
加载聊天历史
显示聊天界面
用户操作
否
上传文件
结束咨询
选择文件
确认结束咨询?
未到时间
已过期
发送消息
是
验证文件格式
结束咨询



业务流程说明

这个流程实现了基于预约的实时医患在线咨询功能，支持文本消息和文件传输，并包含完整的咨询记录管理。

关键技术实现

消息模型 (models.py):

```
class MessageModel(db.Model):
    __tablename__ = 'message'
    id = db.Column(db.Integer, primary_key=True, autoincrement=True)
    from_user = db.Column(db.String(50), nullable=False)
    from_user_avatar = db.Column(db.String(255), nullable=True)
    to_user = db.Column(db.String(50), nullable=False)
    to_user_avatar = db.Column(db.String(255), nullable=True)
    content = db.Column(db.Text, nullable=False)
    time = db.Column(db.DateTime, nullable=False, default=datetime.now)
    read = db.Column(db.Integer, nullable=False, default=False)
    type = db.Column(db.String(50), nullable=False)

    def to_dict(self):
        return {
            "from_user": self.from_user,
            "from_user_avatar": self.from_user_avatar,
            "to_user": self.to_user,
            "to_user_avatar": self.to_user_avatar,
            "content": self.content,
            "time": self.time.isoformat(),
            "read": bool(self.read),
            "type": self.type
        }
```

WebSocket实时通信 (consultant.py):

```
from flask_socketio import join_room, emit
from exts import socketio, db

@socketio.on('connect')
def connect():
    print("Client connected")

@socketio.on('disconnect')
def disconnect():
    print("disconnected")

@socketio.on('sendMessage')
def message(data):
    from_user = data['from_user']
    from_user_avatar = data['from_user_avatar']
    to_user = data['to_user']
    to_user_avatar = data['to_user_avatar']
    content = data['content']
    read = 0
    type = data['type']
    try:
        message = MessageModel(from_user=from_user,
from_user_avatar=from_user_avatar,
                               to_user=to_user, to_user_avatar=to_user_avatar,
                               content=content, read=read, type=type)
        db.session.add(message)
        db.session.commit()
        emit('newMessage', message.to_dict(), broadcast=True)
```

```python
    except Exception as e:
        print("Error saving message:", e)
        db.session.rollback()
```

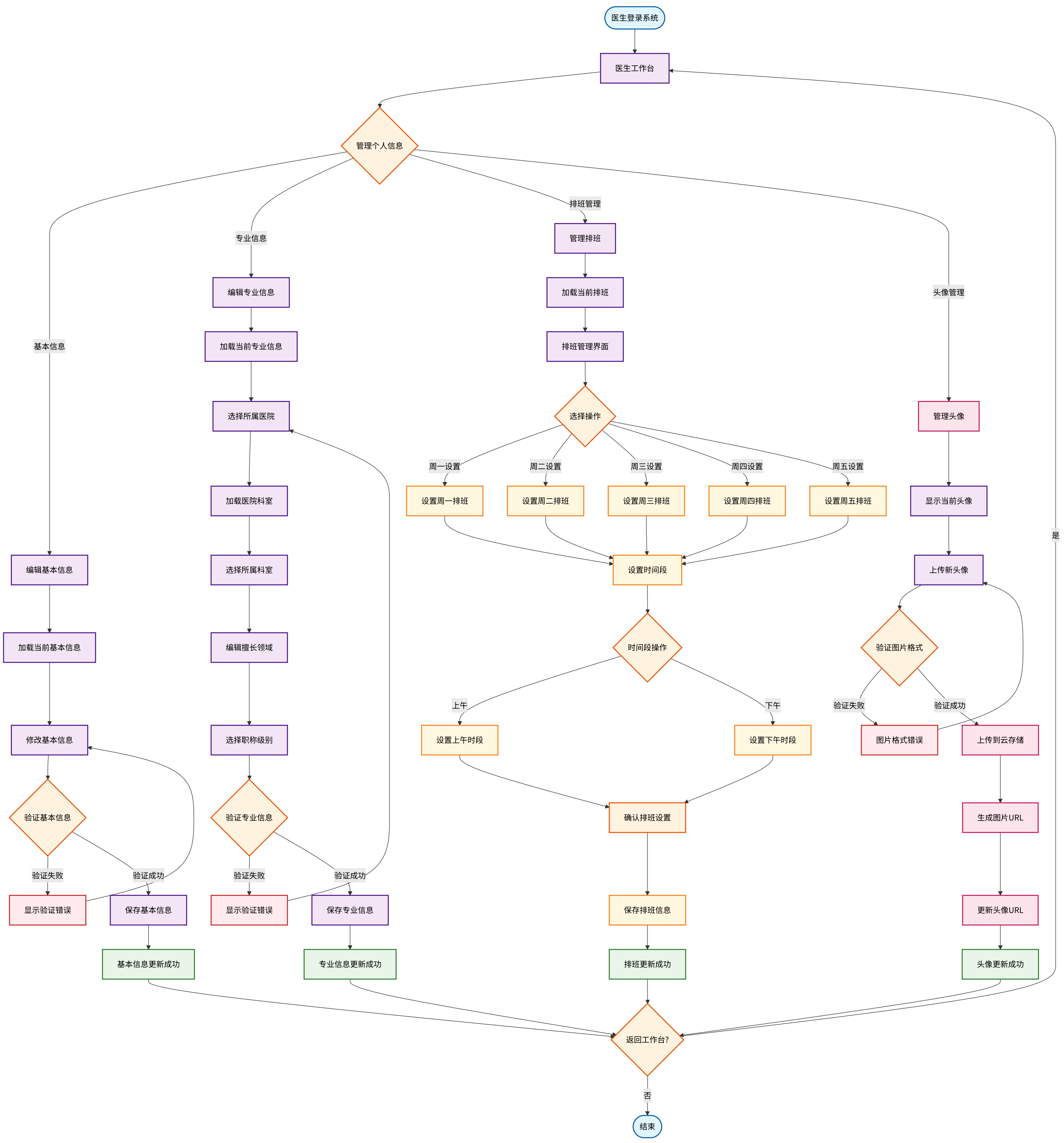
文件上传功能 (utils.py):

```python
def upload_file(file_object, file_name):
    access_key_id = os.getenv('OSS_ACCESS_KEY_ID')
    access_key_secret = os.getenv('OSS_ACCESS_KEY_SECRET')
    endpoint = os.getenv('OSS_ENDPOINT')
    bucket_name = os.getenv('OSS_BUCKET_NAME')

    auth = oss2.Auth(access_key_id, access_key_secret)
    bucket = oss2.Bucket(auth, endpoint, bucket_name)

    try:
        bucket.put_object(file_name, file_object.stream)
    except oss2.exceptions.OssError as e:
        raise e
    except Exception as e:
        raise e

    file_url = f"https://{bucket_name}.{endpoint}/{file_name}"
    return file_url
```

流程特点分析

1. **预约制咨询**: 基于已有预约记录进行咨询，确保服务的有序性
2. **实时通信**: 使用WebSocket技术实现实时消息推送
3. **多媒体支持**: 支持文本消息和文件上传，满足医疗咨询的多样化需求
4. **数据持久化**: 所有聊天记录保存到数据库，便于后续查询和管理

4. 医生个人信息管理流程



业务流程说明

医生可以通过该流程管理个人基本信息、专业信息、工作排班和头像等，确保患者能够获取准确的医生信息。

关键技术实现

医生详细信息模型 (models.py):

```
class DoctorInfoModel(db.Model):
    __tablename__ = 'doctor_info'
    id = db.Column(db.Integer, db.ForeignKey('doctor.id'),primary_key=True)
    phone = db.Column(db.String(11), unique=True, nullable=False)
    name = db.Column(db.String(50), nullable=False)
    gender = db.Column(db.Enum('male', 'female'), nullable=True)
    hospital_id = db.Column(db.Integer, db.ForeignKey('hospital.id'),
nullable=True)
    internal_id = db.Column(db.String(8), nullable=True)
    department_id = db.Column(db.Integer, db.ForeignKey('department.id'))
    position_rank = db.Column(db.Enum(
        'resident',  # 住院医师
        'attending',  # 主治医师
        'associate_chief',  # 副主任医师
        'chief'  # 主任医师
    ), nullable=True)
    specialty = db.Column(db.Text)
    birth_date = db.Column(db.Date)
    avatar_url = db.Column(db.String(255))
    schedule = db.Column(db.JSON, nullable=True, default=lambda: {
        "monday": {"morning": False, "afternoon": False},
        "tuesday": {"morning": False, "afternoon": False},
        "wednesday": {"morning": False, "afternoon": False},
        "thursday": {"morning": False, "afternoon": False},
        "friday": {"morning": False, "afternoon": False}
    })

    def to_dict(self):
        return {
            "id": self.id,
            "phone": self.phone,
            "name": self.name,
            "gender": self.gender,
            "hospital_id": self.hospital_id,
            "hospital_name": self.hospital.name if self.hospital else None,
            "department_id": self.department_id,
            "department_name": self.department.name if self.department else
None,
            "position_rank": self.position_rank,
            "specialty": self.specialty,
            "avatar_url": self.avatar_url,
            "schedule": self.schedule,
        }
```

医生信息视图对象 (vo.py):

```python
class DoctorInfoVO:
    def __init__(self, phone, name, gender, hospital, department, internal_id,
position_rank, specialty, birth_date, avatar_url, schedule):
        self.phone = phone
        self.name = name
        self.gender = gender
        self.hospital = hospital
        self.internal_id = internal_id
        self.department = department
        self.position_rank = position_rank
        self.specialty = specialty
        self.birth_date = birth_date
        self.avatar_url = avatar_url
        self.schedule = schedule
    def to_dict(self):
        return {"phone": self.phone,
                "name": self.name,
                "gender": self.gender,
                "hospital_id": self.hospital,
                "department_id": self.department,
                "internal_id": self.internal_id,
                "position_rank": self.position_rank,
                "specialty": self.specialty,
                "birth_date": self.birth_date,
                "avatar_url": self.avatar_url,
                "schedule": self.schedule}
```

流程特点分析

1. **分类管理**: 将医生信息分为基本信息、专业信息、排班信息和头像四个模块
2. **关联数据验证**: 医院和科室信息需要关联验证，确保数据一致性
3. **排班管理**: 医生可以灵活设置周一到周五的上午和下午出诊时间
4. **文件上传**: 头像上传使用阿里云OSS服务

这些活动图和对应的代码实现展示了医疗管理系统的核心业务流程，每个流程都有对应的数据模型支撑，确保了系统的数据一致性和业务逻辑的完整性。