We then compute a color mapping function between our resized input and output image. Work in [16, 21] evaluated several types of polynomial mapping functions and showed their effectiveness to achieve nonlinear color mapping. Accordingly, we computed a polynomial mapping matrix M that globally maps values of $\psi\left(\mathbf{I}_{\mathrm{WB}^{(\mathrm{in})}\downarrow}\right)$ to the colors of our generated image $\hat{\mathbf{I}}_{\mathrm{WB}^{(\mathrm{i})}\downarrow}$, where $\psi(\cdot)$ is a polynomial kernel function that maps the image's RGB vectors to a higher 11-dimensional space—see supplemental materials for an evaluation of different kernel functions. This mapping matrix M can be computed in a closed-form solution, as demonstrated in [2, 3].

Once M is computed, we obtain our final result in the same input image resolution using the following equation [3]:

$$\hat{\mathbf{I}}_{\mathrm{WB}^{(\mathrm{i})}} = \mathbf{M}\psi\left(\mathbf{I}_{\mathrm{WB}^{(\mathrm{in})}}\right). \quad (4)$$

$$\begin{bmatrix} r & g & b & rg & rb & gb & r^2 & g^2 & b^2 & rgb & 1 \end{bmatrix}$$

$$\begin{bmatrix} r & g & b & rg & rb & gb & r^2 & g^2 & b^2 & rgb & 1 \end{bmatrix} \mathrm{M}_{11\mathrm{x}3} = \begin{matrix} \mathrm{R} \\ \mathrm{G} \\ \mathrm{B} \end{matrix} \qquad \begin{matrix} \mathrm{R} \\ \mathrm{G} \\ \mathrm{B} \end{matrix} = \mathrm{M}_{3\mathrm{x}11} \begin{bmatrix} r & g & b & rg & rb & gb & r^2 & g^2 & b^2 & rgb & 1 \end{bmatrix}$$

多项式特征

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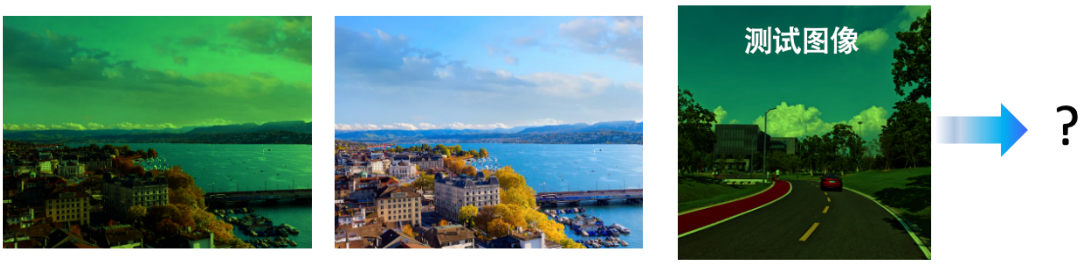

用最小二乘法建模输入 r、g、b 的多项式特征（11 维）与输出 r、g、b 的关系，然后给出测试图像对应的结果。

要求：请提供完整的 PyTorch 实现代码（不依赖现成的最小二乘库函数，且代码长度控制在 100 行以内），并给出相应的测试结果。

提交材料：**学号-姓名-作业 1.pdf**。文档内容应包含可运行的完整代码及其测试结果。禁止提交非 PDF 格式文件，若未按要求提交，将扣 2 分。

提交网址：https://box.nju.edu.cn/u/d/763fb7aaa1e24c7fa1c5/